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# The Ohio Coal Supply and Its Exhaustion

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# The Ohio Coal Supply and Its Exhaustion



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## INTRODUCTION.

The importance of **coal** in modern civilization cannot be overestimated. It offers to mankind **solar energy** in its most concentrated form. It is the father of modern civilization. The great coal producing nations of the world which have been developed by its use, viz., the United States, Great Britain, Germany, France, Austro-Hungary, Belgium, Russia, and Japan, are the greatest commercial nations. The fires of industry and the centers of population in these countries cluster around their coal supplies. This supply is definite, and it is not inexhaustible. Every ton of it taken out of the earth, or lost in mining, or wasted in using leaves just that much less for the future needs of the world.

The use of coal as a fuel began within the last hundred years. Its production in the United States in 1850 was 7,000,000 tons, and in 1912 it was 696,000,000 tons. The Ohio production in 1850 was 704,000 tons and 62 years later it was 34,000,000 tons, or nearly 50 times as great.

With such enormous increases in the consumption of coal, the question of the future supply must give concern to all thoughtful men.

The world's supply of coal has not yet been measured. It is doubtful if even the oldest and most civilized of the nations know the amount of their coal supply. Many years of careful exploration are yet needed to define the coal areas in all parts of the world.

Mr. Marius R. Campbell in "The Coal Resources of the World" estimates the original tonnage of the United States at 3,225,394,200,000 tons, and the total production to 1912 at 11,926,140,000 tons, leaving a reserve of 3,213,468,000,000 tons; to which may be added Brook's and Martin's estimate of Alaska, amounting to 19,593,000,000 tons, or a total of 3,233,060,800,000 tons as the coal reserve of the United States and Alaska.

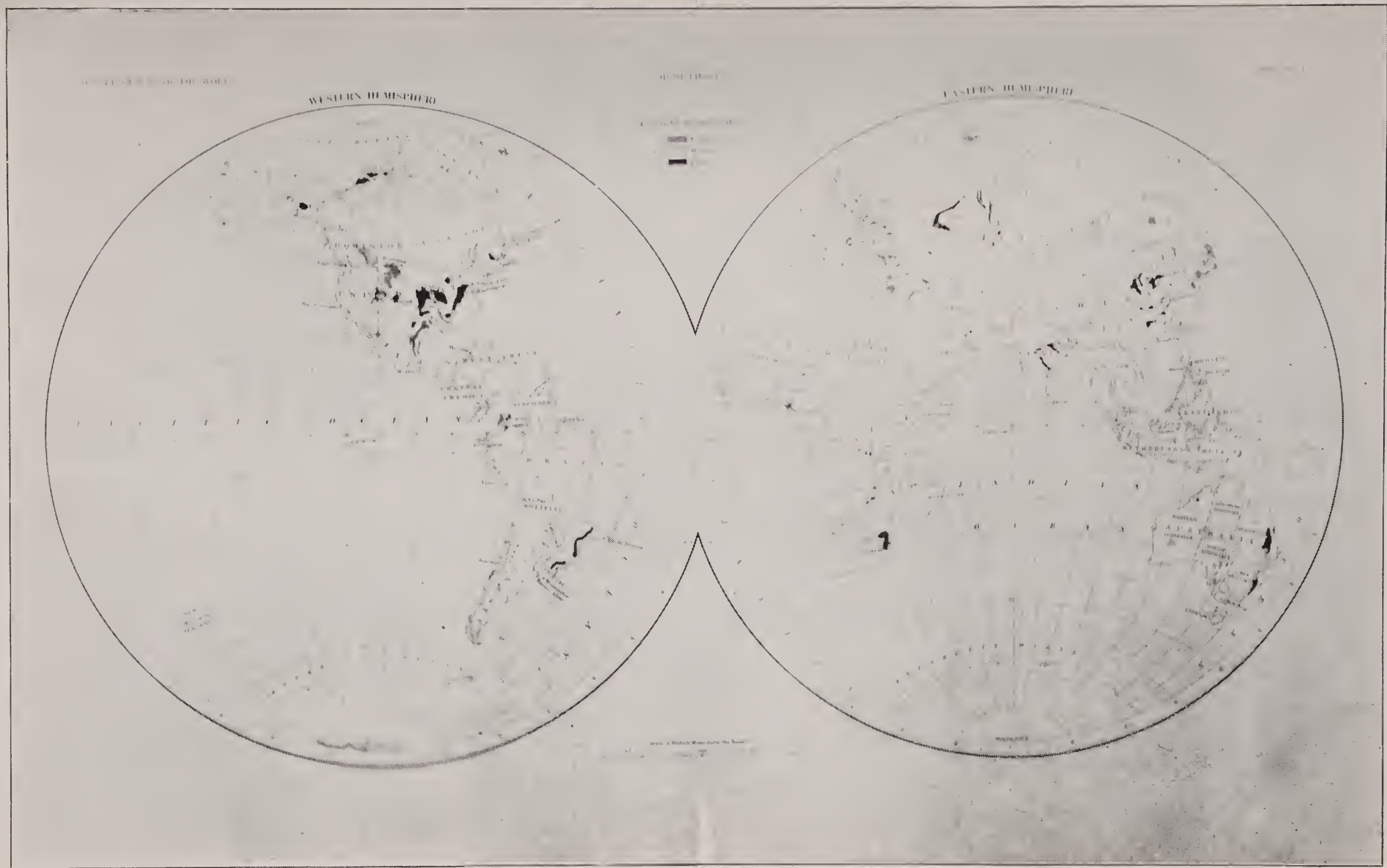
Mr. Campbell estimates the original tonnage of Ohio coals at 85,000,000,000 tons. The total production to 1912, including the estimated losses in mining, amounts to 926,667,000 tons. This would leave a coal reserve for Ohio of about 84 billion tons, which means the equivalent of a continuous coal seam 7 feet thick over the entire area of Ohio coal measures.

The writer hopes to show that such published estimates of the coal reserves at this time cannot be even approximately correct because of our meager knowledge of the coal seams on which all such estimates of coal reserves must be based.

## THE COAL FIELDS OF THE WORLD

In late years our attention has been called by our law-makers to the question of coal reserves, not only for our own State and Nation, but of the world as well. The very large increase in the consumption of coal in recent years makes this a question of grave importance.

Map Page 5 has been taken from "The Coal Resources of the World," and shows the location of the world's coal supply. It will be noted that the greater part lies in the Northern Hemisphere. This is said to be due partly to the larger land areas found there, and partly to the fact that the earlier coal-bearing portions of the carboniferous strata are not represnted in the Southern Hemisphere. The writer is proud to be able to call attention to the fact that our country possesses over one-half of the estimated coal reserves of the world.




**The Coal Areas of the World.** (Indicated by the black spots.)

## ESTIMATE OF THE COAL RESERVES OF THE WORLD IN MILLION TONS.

(See Map, Page 5.

| Country. | Class A Anthracite Including Some Dry Coals. | Classes B and C Bituminous Coal. | Class D Sub-bituminous Brown Coals and Lignites. | Totals. |
|---|---|---|---|---|
| Oceana | 659 | 133,481 | 36,270 | 170,410 |
| Asia | 407,637 | 760,098 | 111,851 | 1,279,586 |
| Africa | 11,662 | 45,123 | 1,054 | 57,839 |
| Newfoundland | ..... | 500 | ..... | 500 |
| Canada | 2,158 | 283,661 | 948,450 | 1,234,269 |
| Central America | ..... | 1 | 4 | 5 |
| South America | 700 | 31,397 | ..... | 32,097 |
| Europe | 54,346 | 693,162 | 36,682 | 784,190 |
| United States | 19,684 | 1,955,521 | 1,863,452 | 3,838,657 |
| Total | 496,846 | 3,902,944 | 2,997,762 | 7,397,553 |

### CLASSES A, B, C, AND D BRIEFLY DEFINED.

Class A. Includes coal that burns with short, blue flame, or with slightly luminous, short flame and little smoke; does not coke and yields from 3 to 5 per cent combustible matter. Fuel ratio, 7 to 12 or over. Calorific value, 8000 to 8060 calories.

Class B. Burns with short, luminous flame and yields 12 to 15 per cent volatile matter; does not readily coke. Fuel ratio, 4 to 7. Calorific value, 8400 to 8900 calories.

Or burns with luminous flame and yields from 12 to 26 per cent volatile matter; generally cokes. Fuel ratio, 1.2 to 7; Calorific value, 7700 to 8800 calories.

Or burns freely with long flame, which stands weathering but fractures readily, and occasionally contains moisture up to 6 per cent. Makes porous coke. Fuel ratio, 2.5 to 3.3. Calorific value, 6600 to 7800 calories.

Class C. Burns with long, smoky flame; yields from 30 to 40 per cent volatile matter on distillation, leaving a very porous coke. Fracture generally resinous. Calorific value, 6600 to 880 calories.

Class D. Contains generally over 6 per cent of moisture; disintegrates on drying; streak brown or yellow; cleavage indistinct; moisture in fresh-mined, commercial output up to 20 per cent; fracture generally conchoidal; earthy and dull; drying-cracks irregular, curved lines. Calorific value, 5500 to 7200 calories, or moisture in commercial output over 20 per cent. Calorific value, 4000 to 6000 calories.

(Taken from "The Coal Resources of the World," Vol. 1, Page X to XIII, inclusive.)

## THE COAL FIELDS OF THE UNITED STATES.

(See Map, Page 8.)

There are seven general coal areas in the United States.

**The Pennsylvania Anthracite Fields** cover 480 square miles.

**The Appalachian Coal Field** covers the coal area in Ohio, Pennsylvania, West Virginia, Virginia, Eastern Kentucky, Tennessee, and Alabama, amounting to an estimated area of 69,485 square miles.

**The Interior Fields** include the coal of Michigan, Indiana, Western Kentucky, Illinois, Iowa, Missouri, Kansas, Oklahoma, Arkansas, and Texas, amounting to an estimated area of 132,900 square miles.

**The Gulf, or Lignite Field** includes the lignite coal bordering the Gulf of Mexico, lying in the States of Arkansas and Texas, amounting to an estimated area of 2,100 square miles.

**The Rock Mountain Fields** include the lignite and bituminous coals of North and South Dakota, Montana, Wyoming, Colorado, New Mexico, Idaho, Utah, Arizona, amounting to 126,022 square miles of known coal fields.

**The Pacific Coal Fields** include the coal areas of Washington, Oregon, and California, amounting to 1900 square miles. The total bituminous coal embraced by these regions given in "The Coal Resources of the World" amounts to a little less than 340,000 square miles.

COAL FIELDS
OF THE
UNITED STATES
Showing areas of coal-bearing formations
School of Mines - Ohio State University
April 29 1904
LEGEND
Tertiary
Cretaceous
Triassic
Carboniferous
CANADA
PACIFIC OCEAN
ATLANTIC OCEAN
GULF OF MEXICO
ROCKY MOUNTAIN FIELDS
WESTERN INTERIOR
EASTERN INTERIOR
NORTHERN INTERIOR
LAKE MICHIGAN
LAKE HURON
LAKE ONTARIO
LAKE ERIE
LAKE SUPERIOR
NEW MEXICO
Rio Gila
Colorado
Rio Grande
10

# ESTIMATE OF ORIGINAL TONNAGE OF COAL IN THE UNITED STATES.

BY MARIUS R. CAMPBELL.

| Province, State, and Field. | Areas in Square Miles. | | | Estimated. | | Original Amount of Coal in Metric Tons. | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Known Coal Field. | Possible Coal Field. | Coal below a Depth of 3,000 Feet. | Lignite (No. 2, Class D.) | Subbituminous Coal (No. 1, Class D.) | Bituminous Coal (Class C and No. 2, Class B.) | Semibituminous Coal (No. 1, Class B.) | Anthracite and Semianthracite Coal. (Class A.) | Coal below surface from 3,,000 to 6,000 Feet. | Total production of coal to end of 1910. |
| Eastern Province— Penna. | | | | | | | | | | |
| Anthracite region | 480 | ..... | ..... | ..... | ..... | ..... | ..... | 19,056,300,000 | ..... | 1,978,525,100 |
| Bituminous field | 14,200 | ..... | ..... | ..... | ..... | 93,080,000,000 | 9,074,000,000 | ..... | ..... | 2,043,319,940 |
| Ohio | 12,660 | ..... | ..... | ..... | ..... | 85,270,000,000 | ..... | ..... | ..... | 527,395,010 |
| Maryland | 455 | ..... | ..... | ..... | ..... | 1,368,000,000 | 5,932,000,000 | ..... | ..... | 146,301,270 |
| West Virginia | 17,000 | ..... | ..... | ..... | ..... | 111,293,500,000 | 27,132,000,000 | ..... | ..... | 535,042,310 |
| Kentucky | 10,270 | ..... | ..... | ..... | ..... | 61,513,000,000 | ..... | ..... | ..... | See below |
| Virginia | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 66,014,890 |
| Southwestern fields | 1,550 | ..... | ..... | ..... | ..... | 18,829,400,000 | 227,000,000 | ..... | ..... | ..... |
| Brushy Mt. fields | 200 | ..... | ..... | ..... | ..... | ..... | ..... | *817,000,000 | ..... | ..... |
| Atlantic Coast region | 150 | ..... | ..... | ..... | ..... | 544,000,000 | ..... | ..... | ..... | ..... |
| North Carolina | 60 | ..... | ..... | ..... | ..... | 181,500,000 | ..... | ..... | ..... | 432,670 |
| Tennessee | 4,400 | ..... | ..... | ..... | ..... | 23,289,500,000 | ..... | ..... | ..... | 94,359,160 |
| Georgia | 167 | ..... | ..... | ..... | ..... | 846,600,000 | ..... | ..... | ..... | 7,964,570 |
| Alabama | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 187,072,430 |
| Warrior and Plateau fields | 7,845 | ..... | ..... | ..... | ..... | 57,634,600,000 | ..... | ..... | ..... | ..... |
| Cahaba field | 268 | 82 | * | ..... | ..... | 3,421,000,000 | ..... | ..... | ..... | ..... |
| Coosa field | 260 | ..... | ..... | ..... | ..... | 272,000,000 | ..... | ..... | ..... | ..... |
| | 69,965 | 82 | ..... | ..... | ..... | 457,543,100,000 | 42,365,000,000 | 19,873,300,000 | ..... | ..... |
| Interior Province— | | | | | | | | | | |
| Michigan | 11,000 | ..... | ..... | ..... | ..... | 10,889,300,000 | ..... | ..... | ..... | 17,239,220 |
| Indiana | 6,500 | ..... | ..... | ..... | ..... | 48,140,700,000 | ..... | ..... | ..... | 186,006,680 |
| Kentucky | 4,900 | 1,500 | ..... | ..... | ..... | 50,400,000,000 | ..... | ..... | ..... | 143,350,120 |
| Illinois | 35,600 | ..... | ..... | ..... | ..... | 182,758,400,000 | ..... | ..... | ..... | 717,180,790 |
| Iowa | 12,560 | ..... | ..... | ..... | ..... | 26,461,000,000 | ..... | ..... | ..... | 149,234,110 |
| Missouri | 23,960 | ..... | ..... | ..... | ..... | 76,225,000,000 | ..... | ..... | ..... | 97,706,150 |
| Kansas | 18,600 | ..... | ..... | ..... | ..... | 27,223,200,000 | ..... | ..... | ..... | 99,210,200 |
| Oklahoma | 10,000 | ..... | ..... | ..... | ..... | 49,865,200,000 | ..... | ..... | ..... | 44,064,190 |
| Arkansas | 1,580 | ..... | ..... | ..... | ..... | 154,000,000 | 1,112,800,000 | *363,000,000 | ..... | 27,330,060 |
| Texas | 8,200 | 5,300 | ..... | ..... | ..... | 7,259,500,000 | ..... | ..... | ..... | 18,200,490 |
| | 132,900 | 6,800 | ..... | ..... | ..... | 479,377,200,000 | 1,112,800,000 | 363,000,000 | ..... | ..... |

*Probably exceeds 3,000 in depth.

*Parker, E. W. Mineral Res. of U. S. for 1910. *Semianthracite.

## ESTIMATE OF ORIGINAL TONNAGE OF COAL IN THE UNITED STATES—Continued.

| Province, State, and Field. | Areas in Square Miles. | | | Estimated. | | Original Amount of Coal in Metric Tons. | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Known Coal Field. | Possible Coal Field. | Coal below a Depth of 3,000 Feet. | Lignite (No. 2, Class D.) | Subbituminous Coal (No. 1, Class D.) | Bituminous Coal (Class C and No. 2, Class B.) | Semibituminous Coal (No. 1, Class B.) | Anthracite and Semianthracite Coal. (Class A.) | Coal below surface from 3,000 to 6,000 feet. | Total production of coal to end of 1910. |
| Gulf Province— | | | | | | | | | | |
| Arkansas | 100 | 5,900 | ..... | 81,700,000 | ..... | ..... | ..... | ..... | ..... | See above |
| Texas | 2,000 | 53,000 | ..... | 20,871,000,000 | ..... | ..... | ..... | ..... | ..... | See above |
| Northern Great Plains Province | 2,100 | 58,900 | ..... | 20,952,700,000 | ..... | ..... | ..... | ..... | ..... | ..... |
| North Dakota | 29,630 | 6,350 | ..... | 633,329,800,000 | ..... | ..... | ..... | ..... | ..... | 3,562,690 |
| South Dakota | 2,160 | 8,820 | ..... | 925,900,000 | ..... | ..... | ..... | ..... | ..... | See below |
| Montana— | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | See below |
| Fort Union region | 33,132 | ..... | ..... | 331,646,700,000 | 4,353,100,000 | ..... | ..... | ..... | ..... | ..... |
| Bull Mt. field | 633 | 457 | ..... | ..... | 2,722,300,000 | ..... | ..... | ..... | ..... | ..... |
| Assinibone region | 3,000 | ..... | ..... | ..... | ..... | 1,814,900,000 | ..... | ..... | ..... | ..... |
| Judith Basin region | 1,500 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | See below |
| Wyoming | ..... | ..... | ..... | ..... | ..... | 120,700,000 | ..... | ..... | ..... | ..... |
| Black Hills region | 320 | ..... | ..... | ..... | 124,750,500,000 | ..... | ..... | ..... | ..... | ..... |
| Powder River region | 10,800 | 3,200 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 131,573,490 |
| Colorado | ..... | ..... | ..... | ..... | 36,297,700,000 | ..... | ..... | ..... | ..... | ..... |
| Denver region | 5,380 | 1,480 | ..... | ..... | ..... | 932,800,000 | ..... | ..... | ..... | ..... |
| Canon City field | 40 | ..... | ..... | ..... | ..... | 22,198,000,000 | ..... | ..... | ..... | ..... |
| Trinidad field | 1,035 | ..... | 80 | ..... | ..... | ..... | ..... | ..... | ..... | 28,223,970 |
| New Mexico | ..... | ..... | ..... | ..... | ..... | 16,270,400,000 | ..... | ..... | ..... | ..... |
| Raton field | 960 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Rocky Mt. Province— | 88,590 | 20,307 | 80 | 965,902,400,000 | 168,123,600,000 | 41,336,800,000 | | | | |
| Montana | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 29,160,000 |
| N. F. Flat Head Ry. field | | | | | | | ..... | ..... | ..... | ..... |
| Mountain fields | 150 | ..... | ..... | ..... | 3,081,700,000 | ..... | ..... | ..... | ..... | ..... |
| Yellowstone region | 10 | 100 | ..... | ..... | 90,700,000 | ..... | ..... | ..... | ..... | ..... |
| Red Lodge-Bridger | 50 | ..... | ..... | ..... | ..... | 42,900,000 | ..... | ..... | ..... | ..... |
| field | 50 | 450 | ..... | ..... | 1,535,200,000 | 552,500,000 | ..... | ..... | ..... | 4,040 |
| Idaho | ..... | ..... | ..... | ..... | 90,700,000 | ..... | ..... | ..... | ..... | ..... |
| Goose Creek field | 30 | ..... | ..... | ..... | ..... | 544,500,000 | ..... | ..... | ..... | ..... |
| St. Anthony field | 200 | 1,000 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 88,234,900 |

# ESTIMATE OF ORIGINAL TONNAGE OF COAL IN THE UNITED STATES—Continued.

| Province, State, and Field. | Areas in Square Miles. | | | Estimated. | | Original Amount of Coal in Metric Tons. | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Known Coal Field. | Possible Coal Field. | Coal below a Depth of 3,000 Feet. | Lignite (No. 2, Class D.) | Subbituminous Coal (No. 1. Class D.) | Bituminous Coal (Class C and No. 2. Class B.) | Semibituminous Coal (No. 1, Class B.) | Anthracite and Semianthracite Coal. (Class A.) | Coal below surface from 3,000 to 6,000 feet. | Total production of coal to end of 1910. |
| Wyoming | ..... | ..... | ..... | ..... | 907,400,000 | ..... | ..... | ..... | 1,800,000,000 | ..... |
| Bighorn Basin region | 905 | 430 | 2,830 | ..... | 1,828,600,000 | ..... | ..... | ..... | 9,100,000,000 | ..... |
| Hanna field | 160 | ..... | 3,340 | ..... | 20,871,000,000 | 9,074,400,000 | ..... | ..... | ..... | ..... |
| Green Ry. Basin reg. | 1,435 | 240 | ..... | ..... | 370,472,000,000 | 57,196,200,000 | ..... | ..... | 180,000,000,000 | ..... |
| Wind Ry. Basin reg. | 6,440 | 870 | 9,970 | ..... | 16,706,000,000 | 6,715,100,000 | ..... | ..... | ..... | ..... |
| Hams Fork region | 600 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Colorado | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | See above |
| North Park field | 57 | 43 | ..... | ..... | 2,588,600,000 | ..... | ..... | ..... | ..... | ..... |
| Yampa field | 3,130 | ..... | ..... | ..... | 37,954,000,000 | 85,025,300,000 | ..... | 20,500,000 | 180,000,000,000 | ..... |
| Unita Basin region | 2,780 | ..... | 3,720 | ..... | ..... | 75,847,500,000 | ..... | 435,900,000 | 130,000,000,000 | ..... |
| South Park field | 3 | 70 | ..... | ..... | ..... | 18,100,000 | ..... | ..... | ..... | ..... |
| Durango field | 1,840 | 20 | ..... | ..... | 17,693,300,000 | 8,504,500,000 | ..... | ..... | ..... | ..... |
| Tongue Mesa field | 40 | ..... | ..... | ..... | ..... | 842,300,000 | ..... | ..... | ..... | ..... |
| S. W. Colorado field | 36 | ..... | ..... | ..... | ..... | 74,000,000 | ..... | ..... | ..... | ..... |
| Utah | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 23,111,320 |
| Uinta Basin region | 3,276 | ..... | 7,530 | ..... | ..... | 76,392,000,000 | ..... | ..... | 91,000,000,000 | ..... |
| Coalville field | 20 | ..... | ..... | ..... | 141,700,000 | ..... | ..... | ..... | ..... | ..... |
| Colob Plateau field | 350 | ..... | ..... | ..... | ..... | *3,629,800,000 | ..... | ..... | ..... | ..... |
| New Mexico— | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| San Juan R. region | 10,700 | ..... | 1,000 | ..... | 150,778,000,000 | ..... | ..... | ..... | 13,000,000,000 | ..... |
| Small fields | 1,560 | ..... | ..... | ..... | 6,125,000,000 | 903,300,000 | ..... | 7,200,000 | ..... | ..... |
| Arizonaa— | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Black Mesa field | 3,580 | ..... | ..... | ..... | 12,776,800,000 | ..... | ..... | ..... | ..... | ..... |
| Small fields | 30 | ..... | ..... | ..... | 55,700,000 | 9,100,000 | ..... | ..... | ..... | ..... |
| | 37,432 | 3,223 | 28,390 | ..... | 643,696,400,000 | 325,371,500,000 | ..... | 463,600,000 | ..... | ..... |

*Includes some impure anthracite.

# ESTIMATE OF ORIGINAL TONNAGE OF COAL IN THE UNITED STATES—Concluded.

| Province, State, and Field. | Areas in Square Miles | | | Estimated. | | Original Amount of Coal in Metric Tons. | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Known Coal Field. | Possible Coal | Coal below a Deptl of 3,000 Feet. | Lignite (No. 2, Class D.) | Sub-bituminous Coal (No. 1, Class D.) | Bituminous Coal (Class C and No. 2, Class B.) | Semi-bituminous Coal (No. 1, Class B.) | Anthracite and Semi-anthracite Coal, (Class A.) | Coal below surface from 3,000 to 6,000 Feet. | Total production of coal to end of 1910 |
| Pacific Coast Province. | | | | | | | | | | |
| Washington | 1,899 | ..... | ..... | ..... | 47,588,800,000 | 10,355,700,000 | ..... | 21,100,000 | ..... | 48,682,210 |
| Oregon | 90 | 140 | ..... | ..... | 907,400,000 | ..... | ..... | ..... | ..... | 1,843,430 |
| California | 10 | 30 | ..... | ..... | 14,900,000 | 25,000,000 | ..... | ..... | ..... | 4,634,030 |
| | 1,900 | 170 | ..... | ..... | 48,511,100,000 | 10,380,700,000 | ..... | 21,100,000 | ..... | *35,374,600 |
| Grand Totals | 339,887 | 89,482 | 28,470 | 986,855,100,000 | 860,331,100,000 | 1,314,009,300,000 | 43,477,800,000 | 20,721,000,000 | ‡604,900,000,000 | 7,480,355,040 |
| Fifty per cent. added for waste | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 3,740,177,520 |
| Estimated amount exhausted | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 11,220,532,560 |
| | ..... | ..... | ..... | 986,855,100,000 | ..... | ..... | ..... | ..... | ..... | ..... |
| | ..... | ..... | ..... | 860,331,100,000 | ..... | ..... | ..... | ..... | ..... | ..... |
| | ..... | ..... | ..... | 1,314,009,300,000 | ..... | ..... | ..... | ..... | ..... | ..... |
| | ..... | ..... | ..... | 43,477,800,000 | ..... | ..... | ..... | ..... | ..... | ..... |
| | ..... | ..... | ..... | 20,721,000,000 | ..... | ..... | ..... | ..... | ..... | ..... |
| Total of all kinds of coal except‡ | ..... | ..... | ..... | 3,225,394,300,000 | ..... | ..... | ..... | ..... | ..... | ..... |

*Colliery consumption, etc.

‡Parker, E. W. Mineral es. of U. S. for 1910.

## TOTAL RUN OF MINE COAL PRODUCED IN OHIO.

### BY YEARS FROM 1828 to 1882, INCLUSIVE.

| Year | Tons | Year | Tons | Year | Tons | Year | Tons |
|---|---|---|---|---|---|---|---|
| 1828 | 20,900 | 1842 | 247,500 | 1856 | 1,023,000 | 1870 | 2,780,113 |
| 1829 | 31,900 | 1843 | 308,000 | 1857 | 1,525,000 | 1871 | 4,400,000 |
| 1830 | 42,900 | 1844 | 374,000 | 1858 | 1,100,000 | 1872 | 5,846,794 |
| 1831 | 53,900 | 1845 | 429,000 | 1859 | 1,166,000 | 1873 | 5,005,028 |
| 1832 | 64,900 | 1846 | 462,000 | 1860 | 1,392,100 | 1874 | 3,594,285 |
| 1833 | 75,900 | 1847 | 528,000 | 1861 | 1,265,000 | 1875 | 5,350,259 |
| 1834 | 86,900 | 1848 | 594,000 | 1862 | 1,320,000 | 1876 | 3,850,000 |
| 1835 | 97,900 | 1849 | 660,000 | 1863 | 1,324,951 | 1877 | 5,775,000 |
| 1836 | 108,900 | 1850 | 704,000 | 1864 | 1,996,562 | 1878 | 6,050,000 |
| 1837 | 119,900 | 1851 | 537,000 | 1865 | 1,689,839 | 1879 | 6,600,000 |
| 1838 | 131,852 | 1852 | 770,000 | 1866 | 2,076,166 | 1880 | 6,716,595 |
| 1839 | 137,500 | 1853 | 836,000 | 1867 | 2,301,567 | 1881 | 10,164,000 |
| 1840 | 159,860 | 1854 | 880,000 | 1868 | 2,723,428 | 1882 | 10,395,000 |
| 1841 | 176,000 | 1855 | 979,000 | 1869 | 2,708,184 | Total | 109,956,583 |

Note:—Years 1828 to 1839, inclusive, interpolated by F. A. Ray.

Years 1840 to 1882, inclusive, taken from Mineral Resources.

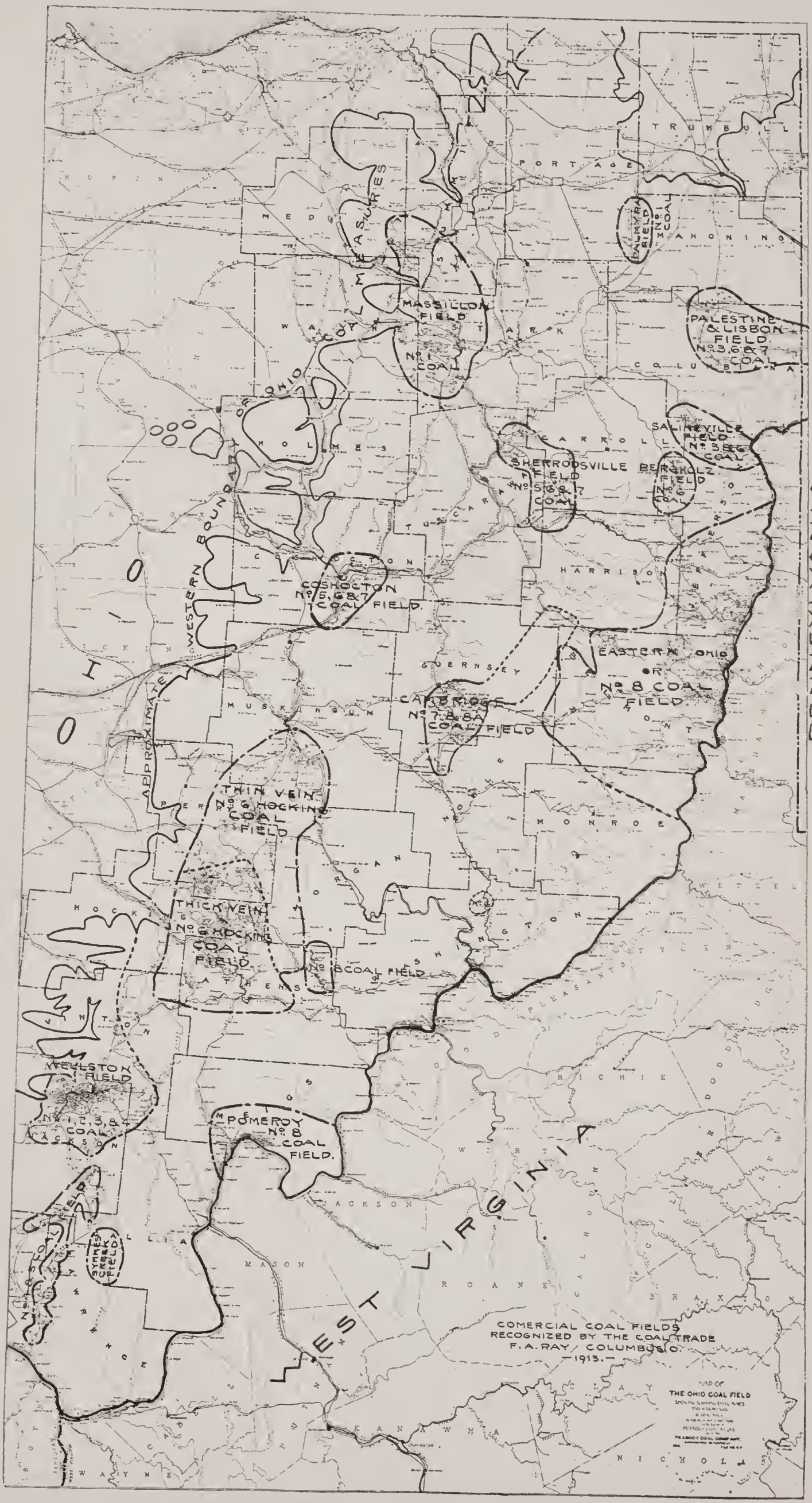
Vol. 2, 1908—Tonnage as given in Mineral Resources is for lump and nut coal to which F A. Ray has added 10% for slack coal.

The area of Ohio coal measures amounts to 11,396 square miles, or about one-thirteenth of the coal area of the United States. It must be remembered that these figures are merely estimates, and in the younger states may not be even approximately true.

Alaska is credited with having an area of 1,200 square miles of known coal and 16,000 square miles of possible coal fields. We are liable to find such estimates very misleading approximations.

# PRODUCTION OF COAL IN OHIO BY COUNTIES YEARS 1883-1912.

| Name of Counties. | 1883 | 1884 | 1885 | 1886 | 1887 | 1888 | 1889 | 1890 | 1891 | 1892 | 1893 | 1894 | 1895 | 1896 | 1897 | 1898 | 1899 | 1900 | 1901 | 1902 | 1903 | 1904 | 1905 | 1906 | 1907 | 1908 | 1909 | 1910 | 1911 | 1912 | Totals |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Athens | 915,515 | 627,944 | 823,139 | 899,046 | 1,083,543 | 1,336,698 | 1,466,328 | 1,420,280 | 1,374,320 | 1,590,507 | 1,622,851 | 1,457,579 | 1,435,744 | 1,383,709 | 1,299,454 | 1,533,188 | 1,761,775 | 2,594,859 | 3,066,533 | 3,666,993 | 3,905,904 | 3,854,078 | 3,848,440 | 4,370,912 | 4,753,044 | 4,170,995 | 4,354,074 | 5,943,638 | 4,532,595 | 4,886,476 | 75,990,161 |
| Belmont | 622,326 | 643,129 | 744,446 | 533,779 | 721,767 | 1,108,106 | 814,699 | 827,568 | 1,259,570 | 1,249,423 | 1,277,540 | 1,193,329 | 961,367 | 1,082,964 | 905,378 | 1,168,567 | 1,259,520 | 1,595,369 | 1,544,832 | 2,058,066 | 2,612,025 | 3,283,089 | 3,871,846 | 4,467,295 | 6,355,582 | 5,591,719 | 5,993,418 | 8,336,428 | 8,040,333 | 9,316,850 | 79,440,330 |
| Carroll | 188,615 | 102,531 | 150,695 | 216,630 | 293,328 | 355,092 | 430,995 | 420,078 | 205,521 | 273,272 | 290,259 | 285,180 | 326,670 | 278,296 | 162,537 | 261,535 | 212,051 | 205,641 | 254,510 | 251,652 | 326,095 | 354,594 | 235,826 | 209,360 | 371,542 | 439,080 | 398,085 | 309,328 | 269,687 | 310,018 | 8,388,703 |
| Columbiana | 622,082 | 469,708 | 462,733 | 336,063 | 516,057 | 466,191 | 628,041 | 544,851 | 664,569 | 610,179 | 636,668 | 501,783 | 644,823 | 516,005 | 735,041 | 886,053 | 799,474 | 718,108 | 792,533 | 868,426 | 874,602 | 721,144 | 705,824 | 554,047 | 686,585 | 516,780 | 714,325 | 740,345 | 668,039 | 482,878 | 19,083,897 |
| Coshocton | 86,300 | 56,562 | 99,609 | 52,934 | 12,479 | 167,903 | 156,341 | 146,837 | 205,193 | 244,149 | 305,769 | 181,127 | 161,723 | 342,625 | 326,981 | 342,904 | 364,702 | 366,145 | 360,635 | 410,309 | 422,221 | 326,467 | 388,932 | 358,128 | 397,229 | 366,805 | 390,302 | 435,903 | 438,369 | 356,299 | 8,385,394 |
| Gallia | 10,956 | 20,372 | 16,383 | 17,426 | 15,365 | 16,722 | 14,868 | 15,160 | 18,277 | 19,634 | 5,292 | 13,361 | 10,341 | 6,671 | 15,704 | 17,391 | 14,470 | 16,138 | 15,740 | 26,450 | 23,889 | 18,979 | 18,551 | 43,895 | 36,635 | 13,692 | 9,920 | 13,923 | 17,114 | 27,523 | 530,840 |
| Guernsey | 244,650 | 375,427 | 277,267 | 433,800 | 553,613 | 383,728 | 317,397 | 547,072 | 498,859 | 572,281 | 534,416 | 641,561 | 972,505 | 1,068,453 | 861,776 | 1,176,524 | 1,313,774 | 1,904,381 | 2,094,887 | 2,968,108 | 2,715,946 | 3,084,220 | 2,896,526 | 3,348,934 | 4,009,141 | 2,926,448 | 3,108,686 | 4,473,022 | 3,901,529 | 4,333,963 | 52,538,894 |
| Harrison | ..... | ..... | ..... | 5,509 | 4,032 | 2,865 | 1,080 | 4,792 | 4,316 | 8,646 | 14,698 | 27,537 | 26,003 | 28,391 | 28,159 | 38,144 | 29,852 | 36,087 | 111,847 | 293,841 | 249,106 | 307,206 | 402,679 | 335,928 | 489,118 | 447,805 | 576,162 | 599,741 | 476,914 | 750,831 | 5,301,289 |
| Hocking | 639,159 | 372,694 | 656,441 | 741,571 | 853,063 | 1,086,538 | 911,488 | 1,239,576 | 1,622,429 | 1,863,303 | 1,889,996 | 1,453,391 | 1,432,741 | 1,351,511 | 1,381,414 | 1,254,740 | 1,929,753 | 2,311,679 | 2,348,869 | 2,118,805 | 1,967,636 | 1,894,869 | 1,695,763 | 1,553,507 | 91,32,616 | 1,282,647 | 1,036,743 | 1,451,147 | 1,547,839 | 2,046,175 | 43,328,103 |
| Holmes | 26,400 | 12,052 | 11,459 | 12,670 | 10,526 | 8,121 | 10,142 | 13,358 | 16,811 | 16,666 | 14,181 | 15,616 | 12,665 | 10,164 | 19,313 | 15,601 | 12,321 | 12,966 | 16,548 | 17,187 | 32,099 | 30,850 | 24,820 | 43,080 | 14,447 | 18,768 | 15,844 | 13,203 | 11,242 | 11,059 | 508,302 |
| Jackson | 490,504 | 331,720 | 791,608 | 856,740 | 1,135,005 | 1,088,761 | 1,257,731 | 1,291,778 | 1,598,870 | 1,770,742 | 1,778,770 | 1,499,287 | 2,072,939 | 1,651,199 | 1,649,493 | 1,804,792 | 2,179,757 | 2,319,321 | 2,141,466 | 2,316,123 | 2,412,116 | 1,958,538 | 1,887,904 | 1,452,176 | 1,303,529 | 836,997 | 823,034 | 933,238 | 673,663 | 783,334 | 43,591,741 |
| Jefferson | 221,022 | 316,777 | 271,329 | 275,666 | 293,875 | 243,178 | 294,664 | 571,909 | 666,187 | 879,500 | 1,138,083 | 997,888 | 861,185 | 670,867 | 744,790 | 829,526 | 935,975 | 971,209 | 1,303,308 | 1,789,452 | 2,320,419 | 2,495,375 | 3,337,799 | 2,998,476 | 4,648,263 | 3,565,008 | 4,056,148 | 5,111,563 | 4,321,829 | 4,641,908 | 51,773,178 |
| Lawrence | 170,793 | 176,412 | 145,916 | 166,933 | 143,559 | 137,806 | 111,815 | 108,505 | 88,440 | 127,074 | 80,741 | 75,292 | 125,280 | 81,746 | 124,448 | 68,835 | 135,064 | 112,873 | 143,678 | 186,635 | 249,139 | 194,192 | 212,949 | 257,049 | 246,562 | 180,265 | 214,685 | 190,465 | 84,567 | 88,104 | 4,429,822 |
| Mahoning | 266,371 | 241,599 | 275,944 | 313,040 | 272,349 | 231,035 | 217,118 | 228,761 | 232,346 | 242,515 | 198,370 | 97,062 | 101,866 | 52,277 | 92,283 | 75,149 | 74,309 | 109,348 | 52,765 | 94,773 | 89,218 | 86,495 | 117,074 | 121,412 | 95,280 | 86,326 | 63,974 | 66,312 | 64,276 | 47,511 | 4,307,158 |
| Medina | 316,780 | 77,160 | 152,721 | 252,411 | 225,487 | 198,452 | 132,706 | 181,861 | 157,410 | 220,149 | 197,405 | 143,196 | 265,411 | 195,669 | 159,987 | 147,714 | 158,216 | 152,767 | 183,391 | 139,933 | 136,803 | 103,910 | 91,205 | 104,729 | 47,181 | 18,103 | 12,465 | 27,604 | 16,942 | 10,395 | 4,228,163 |
| Meigs | 397,557 | 248,436 | 234,756 | 192,263 | 185,205 | 242,483 | 228,156 | 268,599 | 299,402 | 308,127 | 278,562 | 219,971 | 216,897 | 259,296 | 203,861 | 193,335 | 225,149 | 249,060 | 255,892 | 340,700 | 388,568 | 212,395 | 370,587 | 530,476 | 375,033 | 482,630 | 543,595 | 648,149 | 532,840 | 635,940 | 9,767,920 |
| Muskingum | 37,400 | 84,398 | 86,846 | 96,601 | 171,928 | 211,861 | 232,298 | 249,666 | 232,918 | 264,473 | 364,067 | 248,256 | 255,230 | 264,105 | 339,660 | 250,718 | 220,854 | 311,547 | 226,375 | 286,532 | 305,933 | 300,310 | 242,011 | 368,320 | 442,278 | 436,947 | 416,217 | 270,416 | 410,777 | 522,198 | 8,151,170 |
| Noble | ..... | ..... | ..... | 3,342 | 6,320 | 6,200 | 14,281 | 11,565 | 9,560 | 9,095 | 15,360 | 21,867 | 19,376 | 42,507 | 63,967 | 62,912 | 66,714 | 89,046 | 82,844 | 34,992 | 52,247 | 154,970 | 171,509 | 409,114 | 309,349 | 208,192 | 379,055 | 441,823 | 480,524 | 641,677 | 3,809,308 |
| Perry | 1,885,199 | 1,379,100 | 1,259,592 | 1,607,666 | 1,870,841 | 1,736,805 | 1,549,450 | 1,714,762 | 1,759,790 | 2,056,896 | 2,171,495 | 1,460,831 | 1,789,109 | 1,703,816 | 1,449,178 | 1,789,890 | 1,748,522 | 2,517,258 | 2,563,051 | 2,830,962 | 2,731,595 | 2,491,682 | 2,390,570 | 2,609,701 | 2,921,754 | 2,108,050 | 2,076,407 | 2,394,961 | 2,021,594 | 2,164,130 | 60,754,657 |
| Portage | 79,500 | 65,647 | 77,071 | 70,339 | 65,163 | 70,923 | 65,286 | 70,687 | 68,612 | 87,925 | 94,586 | 92,946 | 87,012 | 48,060 | 79,245 | 75,851 | 114,778 | 103,241 | 86,781 | 97,928 | 101,889 | 97,692 | 83,603 | 109,227 | 96,463 | 88,543 | 102,624 | 105,155 | 115,080 | 33,293 | 2,585,150 |
| Stark | 390,775 | 513,225 | 391,418 | 593,422 | 784,164 | 793,297 | 1,028,649 | 891,430 | 925,370 | 938,519 | 831,024 | 456,728 | 860,733 | 1,056,979 | 777,042 | 867,097 | 1,073,750 | 1,150,232 | 1,049,093 | 1,184,749 | 926,180 | 761,173 | 774,832 | 772,583 | 737,017 | 524,052 | 458,392 | 547,635 | 442,860 | 417,823 | 22,920,248 |
| Summit | 185,500 | 253,148 | 145,134 | 82,225 | 95,815 | 112,024 | 84,438 | 189,362 | 143,549 | 110,299 | 97,040 | 27,322 | 49,260 | 53,666 | 83,238 | 65,378 | 86,100 | 122,983 | 123,541 | 93,588 | 44,329 | 84,208 | 115,529 | 96,997 | 99,971 | 103,299 | 78,268 | 94,346 | 85,711 | 82,032 | 3,088,303 |
| Trumbull | 500,612 | 257,683 | 264,517 | 188,551 | 167,989 | 157,826 | 106,480 | 105,333 | 64,173 | 55,775 | 23,152 | 33,137 | 29,809 | 7,173 | 10,838 | 7,471 | 11,059 | 19,181 | 12,148 | 8,143 | 8,476 | 6,535 | 3,591 | 1,956 | 1,895 | 7,534 | 5,405 | 4,716 | 3,496 | 2,989 | 2,077,722 |
| Tuscarawas | 394,066 | 317,141 | 285,545 | 267,666 | 506,466 | 546,117 | 643,866 | 565,105 | 733,374 | 887,106 | 794,681 | 651,903 | 753,286 | 613,563 | 730,473 | 950,913 | 1,053,938 | 1,267,185 | 1,324,570 | 1,577,654 | 1,328,951 | 1,296,876 | 1,361,394 | 1,429,565 | 1,776,566 | 1,331,248 | 1,513,900 | 811,732 | 670,251 | 1,311,301 | 27,696,452 |
| Vinton | 47,800 | 69,740 | 77,127 | 60,013 | 89,727 | 108,695 | 98,749 | 86,611 | 104,366 | 88,305 | 76,144 | 62,496 | 61,068 | 46,503 | 75,445 | 85,144 | 71,072 | 77,231 | 88,024 | 110,423 | 154,934 | 240,524 | 224,275 | 220,904 | 249,475 | 183,542 | 128,728 | 159,006 | 129,986 | 100,084 | 3,376,141 |
| Washington | ..... | 5,600 | 5,000 | 5,500 | 1,880 | 2,432 | 2,770 | 3,835 | 3,796 | 3,480 | 1,936 | 2,000 | 4,533 | 3,646 | 2,974 | 3,634 | 2,090 | 2,679 | 1,738 | 3,930 | 4,000 | 3,800 | 3,600 | 1,920 | 691 | 1,304 | 1,232 | ..... | 355 | 523 | 81,478 |
| Wayne | 162,847 | 120,571 | 81,507 | 109,057 | 105,150 | 91,157 | 86,549 | 71,431 | 91,553 | 80,188 | 64,934 | 32,142 | 119,015 | 69,058 | 84,052 | 41,598 | 18,557 | 45,566 | 31,530 | 94,015 | 97,952 | 123,520 | 165,224 | 204,573 | 204,773 | 125,525 | 86,987 | 164,724 | 202,329 | 184,381 | 3,160,545 |
| Morgan | ..... | 7,636 | 5,536 | 4,370 | 4,100 | ..... | ..... | ..... | ..... | 19,000 | 14,500 | 13,599 | 17,930 | 19,080 | 22,165 | 26,940 | 24,881 | 29,954 | 33,504 | 50,437 | 82,315 | 83,700 | 173,551 | 222,891 | 290,422 | 217,036 | 187,241 | 126,544 | 175,699 | 196,622 | 2,004,653 |
| Scioto | ..... | 3,650 | 2,440 | ..... | ..... | ..... | ..... | 1,090 | ..... | 1,150 | 769 | 1,397 | 3,875 | 1,785 | 17,119 | 12,140 | 8,424 | 11,657 | 10,349 | 8,351 | 8,515 | 12,224 | 9,013 | 10,331 | 13,508 | 8,460 | 8,916 | 9,834 | 5,599 | 7,794 | 178,414 |
| Monroe | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 4,868 | 2,411 | 5,483 | 2,835 | 2,807 | 4,451 | 2,720 | 2,933 | 308 | 132 | 164 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 180 | 29,292 |
| Total | 8,902,729 | 7,650,062 | 7,816,179 | 8,435,215 | 10,301,700 | 10,910,946 | 10,907,385 | 11,788,859 | 13,050,187 | 14,599,908 | 14,828,097 | 11,910,219 | 13,683,879 | 12,912,608 | 12,448,822 | 14,058,135 | 15,908,934 | 19,426,649 | 20,321,290 | 23,929,267 | 24,573,266 | 24,583,815 | 25,834,657 | 27,213,495 | 32,365,949 | 26,287,800 | 27,755,032 | 34,424,951 | 30,342,029 | 34,444,291 | 551,507,428 |
| Total tons produced, year 1828 to 1882, inclusive | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 109,956,583 |
| Total production to 1912 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 661,464,011 |



COMERCIAL COAL FIELDS
RECOGNIZED BY THE COAL TRADE
F. A. RAY / COLUMBUS, O.
—1913.—
MAP OF
THE OHIO COAL FIELD
PENNSYLVANIA
WEST VIRGINIA
OHIO
APPROXIMATE WESTERN BOUNDARY OF OHIO COAL MEASURES
MASSILLON FIELD No. 1 COAL
PALMYRA FIELD No. 1 COAL
PALESTINE & LISBON FIELD No. 3, 6 & 7 COAL
SALINEVILLE FIELD No. 3 & 6 COAL
SHERRODSVILLE FIELD No. 5, 6 & 7 COAL
BERGHOLZ FIELD No. 6 COAL
COSHOCTON No. 5, 6 & 7 COAL FIELD.
EASTERN OHIO No. 8 COAL FIELD.
CAMBRIDGE No. 7 & 8A COAL FIELD
THIN VEIN No. 6 HOCKING COAL FIELD
THICK VEIN No. 6 HOCKING COAL FIELD
No. 8 COAL FIELD
WELLSTON FIELD No. 1, 2, 3, & 4 COAL
POMEROY No. 8 COAL FIELD.
SYMMES CREEK FIELD
TRUMBULL
PORTAGE
MAHONING
COLUMBIANA
CARROLL
HARRISON
GUERNSEY
MONROE
MUSKINGUM
PERRY
HOCKING
ATHENS
WASHINGTON
WETZEL
TYLER
RICHIE
WIRT
JACKSON
MASON
ROANE
BRAXTON
CLAY
KANAWHA
NICHOLAS
WAYNE
LAWRENCE
JACKSON
VINTON
HOLMES
WAYNE
STARK
MEDINA
HURON

## OHIO COAL DISTRICTS.

The development of the present commercial Ohio coal fields began in most cases with the building of the railroads into them. Some coal was shipped by canal in the early days, but the amount was small in comparison to that produced from the rail coal fields developed later.

There are fifteen districts in the State in which coal is mined from one or more of the nine different seams.

The production of coal from the **Wellston** and **Ironton Fields** began with the completion of the C., H. & D. and the D., T. & I. Railroads about 1880. The Wellston and Jackson fields have been actively producting coal from Nos. 1, 2, 3, and 4 coal seams for about thirty-four years.

The development of the **Hocking Thick and Thin Vein No. 6 Field** began in a small way with the construction of the Hocking Valley branch of the Ohio canal. The first mines were located at Chauncey and Nelsonville. The best market at that time was the old Neil House at Columbus. The production of coal from this field did not reach any degree of importance until the building of the Hocking Valley Railroad to Nelsonville in 1869, which was followed by the construction of the Straitsville branch a year later. The Shawnee branch of the B. & O. Railroad was completed to Shawnee in 1872. The Toledo & Ohio Central Railroad was completed to Corning about 1879. The Columbus, Shawnee, and Hocking Railroad was completed to Redfield and Canalville in 1883. The Kanawha and Michigan Railroad was built in 1882. The building of these railroads fixes the time that this field has been active at about 34 years. The most of the production has been from the thick vein No. 6 coal, although some of it has come from the No. 7 seam. The production of the thin vein began about 12 years ago.

Coal began to be shipped from the **Pomeroy Field** by river about 1833. Three years later the first tow boat was built, and the towing of coal in barges began on the Ohio River at Pomeroy. The shipping of all rail coal began in this field at the completion of the Hocking Valley and K. & M. railroad connection to Pomeroy in 1892. The production has all come from the No. 8 seam.

The development of the **Cambridge Field** began in the No. 7 seam with the completion of the Cleveland and Marietta Railroad from Marietta to Canal Dover in 1874. The period of activity in this

field, therefore, has been 40 years, and the production has been largely from the No. 7 seam.

**The Eastern Ohio No. 8 Coal Field** development was begun by Jacob Heatherington and his mule, "Jack," on a three-acre lease near Bellaire in about 1830. The coal was flat-boated to points along the Mississippi River for the use of sugar refineries.

The all-rail coal development in this field has all been made since the completion of the direct railroad outlets to the lakes, and the extension of the Pennsylvania lines into this coal field. The largest development has been within the last twelve years, which has been mainly from the No. 8 seam.

**The Coshocton and the Sherrodsville Fields** are both located on the main line of the Pennsylvania Railroad, and each is provided with an outlet north to the lakes by the Wheeling and Lake Erie Railroad. The development of these fields dates to the completion of these railroads, which was about 1880. The coal seams worked are No. 5, 6, and 7.

**The Bergholz Field** began to develop on the completion of the L. E. & W. Railroad about 1884, in the No. 6 coal.

**The Salineville Field** began with the building of the C. & P. Railroad, and its connection north to the lakes in the No. 3 and No. 6 coal seams.

**The Palestine and Lisbon Coal Fields** were developed by the building of the P., F. W. & C. Railroad. This field is producing coal from the No. 3, 6, and 7 seams.

**The Palmira Field** was brought into operation by the P. L. E. & W. Railroad. Probably the first coal systematically mined in Ohio was mined at Tallmadge, Ohio, and was shipped to Cleveland by Henry Newberry in 1828. It was offered to steamboats as a substitute for wood. The value of Summit County coal was not fully recognized until twenty years later. About this time Governor Todd began mining at Youngstown, and shipments were made by canal. It is claimed that coal was first discovered at Tallmadge, Ohio, in 1825 by F. H. Wright while digging a ground hog out from under a stump. There is some doubt as to where and by whom the discovery of Ohio coal can be credited, since there are varying references made on some of the public records and maps bearing dates of about this time.

**The Massillon Field** was developed by the Cleveland and Mahoning Railroad, which was completed in 1864. Both the Palmira and Massillon fields are producing coal from the No. 1 seam.

The most important of the fifteen coal districts are the Eastern Ohio No. 8 Coal Field, the Thick and Thin Hocking No. 6 coal, and the Cambridge No. 7 Coal District. These three districts alone originally contained two-thirds of the proven Ohio coal reserve.

The annual production of coal from these three districts amounts to over eighty per cent. of the total annual coal production for Ohio.

## THEORY OF COAL FORMATION.

Dr. Edward Orton has said, "Every coal seam was formed at the ocean level; to the generation of a coal field three conditions are indispensable: (1) An abundant growth of vegetation. (2) This growth located at the level of the sea. (3) Oscillations of the earth's crust. All are present in the carboniferous age, not only for this continent, but in Europe and Australia as well. In other portions of the world, and even in our own country, in the Rocky Mountain region, coal fields have been developed at other points in the geological scale, but the same conditions can be traced in all to the very existence of the seam."

It is now believed that the coal regions were at one time a part of the sea and that vast growths of vegetable matter accumulated along the shores, during long periods when the earth's crust was at rest. Following this came a period when the earth subsided when the vegetable growth was covered by the sea and upon which were deposited silt and sand, and at times a growth of limestone.

The action during long intervals of time furnished the shales, the sandstones, and the limestones which "covered the vegetable accumulation with appropriate deposits, to compress them so as to work the strange transformation of vegetable tissue into coal."

The geological column of a coal field shows many coal seams one above another: "Each one standing as it does for a long period of growth, is covered through a movement of subsidence which lets in the sea with its burden of silt and sand."

"We have several examples in our Ohio scale where the sea has held quiet possession long enough to roof over the buried coal swamp with a layer of limestone that requires for its growth a period comparable with that required for the growth of the coal seam itself." If we grant that this theory correctly accounts for the formation of coal seams, then it will require but little imagination for us to see that favorable conditions for the growth of a coal seam would not

likely be equally good in all parts of a region. The subsidence may have been more in one place than in another. The conditions for the growth of vegetation may have more favorable in some places than at others. The periods of rest may have been of shorter duration in the formation of one seam than in another, all of which would explain the irregularities found in coal seams. The large areas of barren territory, the many slate partings, and the inferior quality of some coals, result in the uncertainty of a coal seam carrying true for any considerable distance.

From this theory of coal formation it naturally follows that each of the coal seams forms comparatively narrow strips of coal bordering the sea where it grew. There has been much speculation as to how far back from the outcrop the various coals extend in minable thickness under cover. Some of our greatest geologists place this distance for Ohio coal fields at about 25 miles. None of the coal seams are supposed to cover the entire basin or region. Recent drillings have proven that several of the coal seams may carry true more than a hundred miles from the line of its outcrop.

All of the Ohio coal formations have a general dip of about 30 feet to the mile towards the Ohio River. Haselton's World's Fair charts showed the various Ohio coal seams to cover the entire erea occupied by the coal measures in an unbroken blanket. This made an impressive exposition of Ohio Coal Reserve, but it was far from the truth.

## CLASSIFICATIONS OF OHIO COAL SEAMS.

Some years ago the late R. M. Haselton published a stratigraphical chart, which faithfully shows the order and the generally accepted classification and names of all of the coal seams found in the Ohio scale.

The classification of the coal seams in the Appalachian Region was first made by Professor Lesley for Pennsylvania. He attempted to name the coal seams alphabetically in the order of their occurrence, beginning with the lowest coal in the scale.

Professor Newberry afterwards adopted Lesley's order for the Ohio coals but named them numerically in their order from the bottom upwards. Later Dr. Orton found that Newberry's classification was incomplete and that there were several coal seams that had been left without place or name in the Ohio scale. This made it necessary for him to revise the classification into its present accepted form.

# OHIO

R. M. Hasselline, Columbus O.
Consulting Mining Engineer.
Ex Chief Inspector of Mines, Special Coal Expert
U.S. Geological Survey.

| Classification of Measures | Groups | No. | Coal (Local Name) and Intervening Strata | Thickness of Coal | Thickness of Strata | Distance between Horizons | Where Mined |
|---|---|---|---|---|---|---|---|
| **CARBONIFEROUS** — **UPPER** (Fresh water deposits) — Permo-Carboniferous on Dunkard Creek (- - - Series) | | | Section taken from Monroe & Washington Co's | | | | |
| | | | Cool Blossom | | | | |
| | | | Shales | | | | |
| | | | Limestone (Nineveh) | | | | |
| | | | Shales | | | | |
| | | | Sandstone | | | | |
| | | | Jollytown Coal | 0-1½ | | | |
| | | | Shales | | | | |
| | | | Limestone | | 50-200 | | |
| | | | Sandstone | | | | |
| | | | Shales | | | | |
| | | | Washington Coal (Split) | 1-3 | | | |
| | | | Limestone | | | | |
| | | | Shales | | | | |
| | | | Sandstone (Waynesburg) | | 100-200 | | |
| | | | Shales | | | | |
| Upper Coal Measures | Upper Coal Measures (500) | Monongahela Series | No 8 Macksburg (Waynesburg) | 0-4 | | | Noble Co. |
| | | | Shales | | | | |
| | | | Limestone | | | | |
| | | | * 8° Meigs Creek (Cumberland) | 4 | | | Barnesville, Cumberland |
| | | | Shales | | | | |
| | | | Limestone | | | | |
| | | | * 8 Pittsburgh | 6 | | | Bellaire, Dillonvale, Pomeroy |
| Barren Measures | Lower Barren Measures (300) | | Shales | | | | Moynard |
| | | | Limestone | | | | |
| | | | Shales | | 50-200 | | |
| | | | * 7ᵇ Norwich, Muskingum Co. | 2 | | | Vinton Co. Gallia Co. |
| | | | Shales | | | | Muskingum Co. |
| | | | Limestone (Crinoidal) | | | | |
| | | | Shales (Fossiferous) | | 90 | | |
| | | | Sandstone | | | | |
| | | | Shales | | | | |
| | | | * 7ᵃ Croff Vein, Strip Vein | 3½-5½ | | | Yellow Creek, Salineville |
| | | | Limestone (Cambridge) | | | | |
| | | | Minerium Coal | 1½ | | | |
| | | | Sandstone (Upper Mahoning) | | 30-70 | | |
| | | | Mahoning Coal | 1½ | | | |
| | | | Sandstone (Lower Mahoning) | | | | |
| | | | Shales | | | | |
| Lower Coal Measures (600) | Freeport Group | | * 7 Cambridge, Big Vein | 5-7 | | | Sherrodsville, Salineville |
| | | | Deliver Clay | | | | Bell Roy, Cambridge, |
| | | | Limestone | | | | Happy Hollow, Waterloo. |
| | | | Limestone (Upper Freeport) | | 3 | | |
| | | | Iron Ore | | | | |
| | | | * 6ᵇ Hatcher, Whan, Roger Vein | 3-5 | | | Hatcher, Hampden, Furnace |
| | | | Cement Rock (Lisbon O) | | | | Roger, Steubenville, |
| | | | Sandstone (Lower Freeport) | | | | Lisbon |
| | | | * 6ᵃ Upper Kittaning | 1½ | | | (Not mined in Ohio) |
| | | | Fire Clay | | 1½ | | |
| | | | Sandstone | | 15½ | | |
| | | | Limestone (Buff) | | 3½ | | |
| | | | Shales | | | | |
| | | | * 6 Middle Kittaning (Sheridan) | 2½-13 | | | Osnayburg, Goshen, Pike Run |
| | | | Fire Clay | | 3 | | Conesville, H. Valley, Denison |
| | | | Shales | | 5 | | U. Zanesville, New Lexington |
| | | | Iron Ore (Baird) | | ½ | | |
| | | | Sandstone | | 27 | | |
| | | | * 5 Lower Kittaning | 2½ | | | New Castle, Lectonia O |
| | | | Pattens Vein, Liverpool Clay | | 12-20 | | Ironton, Redfield, Mineral |
| | | | Dust Stone Ore | | | | Point, Hammondsville |
| | | | Ferriferous Limestone | | 5-25 | | |
| | | | Block Ore | | | | |
| | | | Putnam Hill Grey, Hanging Rock I. | | | | |
| | | | * Upper Clarion | 1-6 | | | Sanfield (as Cannel Coal) |
| | | | Fire Clay | | | | Colemans, Columbiana Co. |
| | | | Sandstone (white) | | 6 | | |
| | | | (Not present in Ohio) | | | | |
| | | | Shales | | | | |
| | | | * 4 Brookville Coal | 2 | | | Jackson Co. Vinton Co. |
| Conglomerate Measures "Great Seral" No XII | Serial Conglomerate (300) | | Sandstone (Homewood or Piedmont) | | 30 | | |
| | | | Shales | | | | |
| | | | * 3ᵇ Tionesta Coal | | | | Greentown, N. Industry |
| | | | Upper Blue Limestone (L. Mercer) | | 2½ | | Bolivar, McArthur, |
| | | | Fire Clay | | | | Vinton Furnace. |
| | | | Shales | | | | |
| | | | Flint Limestone (Gore) | | | | |
| | | | * 3ᵃ Bruce Coal (Bryce) | 2-7 | | | Sanfield Tp. Lawrence |
| | | | Fire Clay | | 2-2 | | Co. |
| | | | Shales & Sandstone | | 20-90 | | |
| | | | Iron Ore | | | | The Zoar Limestone is one of the best |
| | | | Limestone (L. Blue) (L. Mercer) Zoar | | 2-6 | | marked geological horizons in L.P.C. |
| | | | Shales | | | | |
| | | | * 3 Wilbur Coal (Flint Ridge) | 3 | | | Millersburg, Wick, McBowell |
| | | | Fire Clay | | 3-15 | | Austintown, Flint Ridge |
| | | | Shales | | 7 | | Licking Co. |
| | | | Sandstone (Massilon) (upper) | | 30-50 | | |
| | | | * 2 Wellston Coal | 12-42 | | | Wellston, Vinton |
| | | | Clay | | 1-5 | | |
| | | | Shales | | 20-70 | | |
| | | | Sandstone (L. Massilon) | | 20-80 | | |
| | | | Gray Slate | | 35-40 | | |
| | | | * 1 Brier Hill, Block | 3-5 | | | Youngstown, Massilon |
| | | | Fire Clay | | 3-5 | | Mineral Ridge, Jackson. |
| | | | Sandstone & Shales | | 10-50 | | |
| | | | Conglomerate Sandstone | | | | |
| **LOWER** Marine Deposits | Mauch Chunk, Red Shale, Umbral Limestone, Greenbrier, etc. No. XI | | | | | | |
| | Pocono Sandstone, Vesperline, No. X, Big Injun Oil Sand | | | | | | |
| Classification of Measures | Groups | No. | Coal (Local Name) and Intervening Strata | Thickness of Coal | Thickness of Strata | Distance between Horizons | Where Mined |

Additional Notes on Ohio
- Coal 7ᵇ = Patriot of Gallia Co
- " 7ᵃ = Salineville Strip
- " 7 = Norris Coal
- " 6ᵃ = Steubenville Shaft
- " 6 = Hammondsville Strip
- " 5 = overlays potters clay at Smith's Ferry
- Upper Clarion Coal = Limestone Coal of Vinton Co.
- Coal 3ᵃ = Strawbridge cannel of Holmes Co
- " 3ᵇ = Huntewell cannel = Bedford Cannel of Coshocton Co
- L. Mercer, Ferriferous, & W. Freeport limestones are important horizons

## COAL SEAMS MINED IN OHIO.

There are 19 seams of coal in Ohio, of which 16 are mined more or less at one or more places within the State. At present only nine of these seams are being mined in Ohio to any great extent, and of these, five are producing more than three-fourths of the State's present total annual production.

**The No. 1 Coal Seam** is the lowest of the minable seams in Ohio. It is an open burning coal and is usually of very high quality, although there are many graduations of quality. This coal is mined in the northern part of the State in Portage, Summit, Stark, and Wayne Counties, and in the southern portion of the State in Jackson and Vinton Counties. This product is very uncertain and lies in small detached bodies rarely exceeding 200 acres in area. This seam has a very uneven floor and does not exceed six feet in thickness, with an average thickness of three feet. The minable area of this coal is small and a considerable part of it is now exhausted.

**The No. 2 Coal Seam** is found in minable thickness in Jackson, Vinton, and Hocking Counties. The coal is of excellent quality. It is high in moisture, but contains less ash than any other Ohio coal. The largest minable area is found in the center of Jackson County. This area is now nearly exhausted. There is an area of undeveloped No. 2 coal along the line between Vinton and Hocking Counties.

**The No. 3 Coal Seam** is mined in Mahoning, Columbiana, and Vinton Counties. Though occurring in 13 counties in Ohio it is not an important coal seam. The coal is liable to be found too impure for market purposes. The thickness varies in different localities, but will average about 3.5 feet in the counties that we have credited with minable areas of this coal.

**The No. 4 Coal Seam** is widely distributed and is on the whole a more valuable seam than the No. 3 coal. There are shipping mines in this coal in Carroll, Gallia, Vinton, Jackson, and Scioto Counties. It is mined in a small way in several other counties in the State.

The Ohio State Geological Survey states that the No. 4 coal seam acquires its largest volume, and perhaps its greatest value, in Coshocton County. There are no mines credited to Coshocton in this coal seam. The coal will average 4 feet in thickness for areas that we have taken into account. This coal is high in ash and sulphur, but is a desirable domestic and steam coal, which will become more important as the more desirable coals become exhausted.

**The No. 5 or Lower Kittanning Coal Seam** is one of the most important seams of the State. It is mined in Carroll, Gallia, Jackson, Lawrence, Mahoning, Tuscarawas, and Vinton Counties. This seam has great steadiness. It is found from two to five feet in thickness and will average 3.25 feet of clean coal on the areas I have considered in making my estimates of proven coal reserves. This coal is so closely connected with its companion, the No. 6 or Middle Kittanning Coal, that a discussion of the stratigraphical relations of the one fits the other.

The Kittanning coal seams have been traced around the whole northern margin of the Appalachian field from Maryland on the east to the central part of Kentucky on the south.

**The No. 6 or Middle Kittanning Coal Seam** is one of the three most important coal seams of the State. It is found from 20 to 50 feet above the No. 5 coal. In Western Pennsylvania it is generally found thin. On the State line there is a small area where it becomes cannel coal, but after crossing the Ohio line it resumes its normal character. In the Yellow Creek Valley in Jefferson County the No. 6 coal becomes an excellent coking coal but rather high in ash. In Columbiana County the seam is thin but generally present. It is minable in Stark County and is thicker in Tuscarawas County where it is generally mined. It carries generally true to McCuneville, Perry County. Throughout this territory the seam is very persistent and regular in every way. Its maximum thickness is from 4 to 5 feet, and its average thickness is 3.5 feet of clean coal. From McCuneville south and westward the seam thickens. There is a large area amounting to about 224 square miles in Athens, Hocking, and Perry Counties, where this coal is from 5 to 13 feet thick, and is locally known as Thick Vein Hocking. This area of thick coal is roughly bounded by the outcrop, on the west; the B. & O. Railway, on the south; the T. & O. C. Railway, on the east, and the Shawnee branch of the B. & O. and the old C., S. & H. Ry. to Corning, on the north. The coal within this boundary averages 7 feet thick. The thin vein No. 6 coal comes in east of Corning and is found of minable thickness east and north everywhere that explorations have been made. It is either thin or cut out entirely for a large area around Amesville, Athens County. The average thickness of the thin No. 6 coal is 3.5 feet of clean coal.

Much of the thick vein No. 6 seam is cut out by the Jumbo Fault, amounting to at least 37 square miles from the center of the thick vein field. This seam is thin in Jackson County, but is somewhat thicker in Gallia and Lawrence Counties. The No. 6 seam is an excellent

domestic coal. It is hard and stands rehandling. It is very desirable for lake shipment.

**The No. 7 or Upper Freeport Seam** ranks third in importance of the Ohio coals. It is mined in Athens, Carroll, Columbiana, Guernsey, Muskingum, Noble, and Tuscarawas Counties. The most important production is from Guernsey County. Generally the coal is moderately cementing, has well-defined cleavage planes, is somewhat soft with medium amount of ash and is liable to be high in sulphur. It is a good steam coal, but does not stand rehandling. Its floor is generally regular. The roof is either a few feet of shale or the Mahoning sandstone. In places this sandstone forms the roof, and has cut out a part or all of the coal. Dr. Orton stated that the strong currents that brought in the sandstone have carried away the shale, and have cut channels of varying widths throughout the body of coal in all fields of No. 7 coal thus far explored, creating "wants," or "horsebacks". These troubles are serious drawbacks to the mining of this coal and render untested areas very uncertain.

**The No. 8 or Pittsburg Coal** is known to be the most valuable coal seam in North America. In all of the states where it occurs it is important. It is found in Pennsylvania, West Virginia, Maryland, and Ohio. The total area in these states is estimated to be from 6,000 to 7,000 square miles. Dr. Orton estimated the area for Ohio alone at 1,250 square miles. There are two distinct fields in Ohio. The Eastern, which is the most important, underlies the whole of Belmont County, the southern half of Jefferson, the eastern portion of Guernsey, probably the northern portion of Monroe, and the northeastern portion of Noble County. The Southern field occupies portions of Morgan, Athens, Meigs, and Gallia Counties.

This coal seam is usually persistent and of characteristic structure. It is at its best along the river in Jefferson and Belmont Counties. Farther west in this field the structure is less constant. In Athens County the structure is decidedly changed. Instead of the usual three benches with the attending slate partings, we have two benches separated by a heavy clay parting. The coal here is not persistent, and is often found with either the top or both benches missing. Dr. Bownocker states, that the Meigs County coal that Dr. Orton named the No. 8 is in reality the Redstone seam that comes about 20 feet above the No. 8 coal.

For the purpose of this publication it has been considered as No. 8. The Pomeroy coal is a very valuable coal for domestic and steam

purposes. The whole of the county has been explored and the limits of minable coal are definitely defined. The clean No. 8 coal will average a little more than 4 feet thick.

The No. 8 coal will coke, but in Ohio its sulphur content is too high to make a coke suited for metallurgical purposes. The Black Diamond Company are making a satisfactory domestic coke at their mines at Lathrop, Ohio. The No. 8 seam promises to live the longest of any of our Ohio coals.

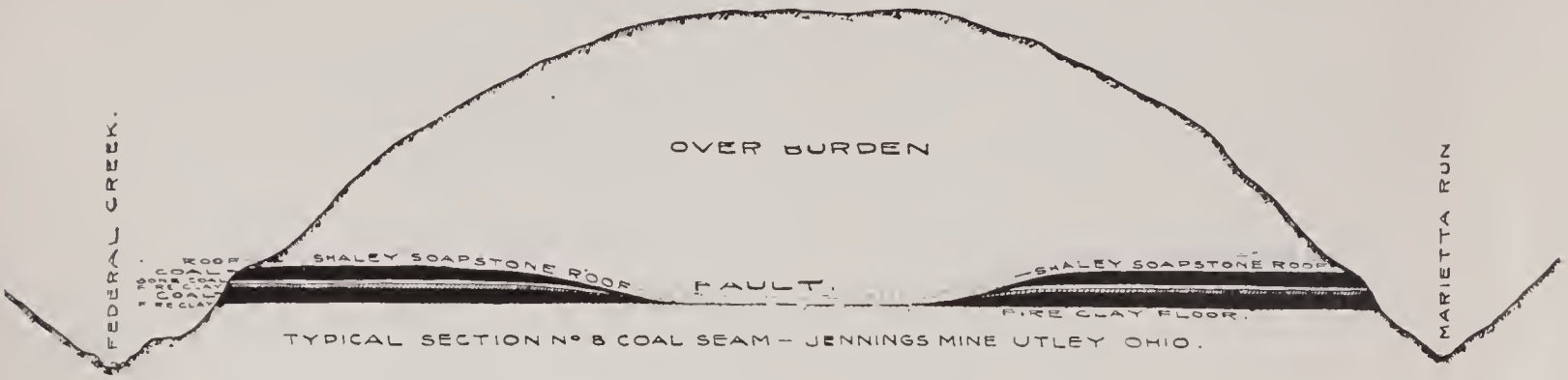
**The No. 8-A or Meigs Creek Seam** has an irregular floor and roof, especially the latter, which would indicate that the conditions under which it was formed were not uniform. This coal lacks persistence. It is a dirty coal, high in ash and sulphur. There is one small operation mining in this seam at Hiramsville, Noble County. I have included this coal seam in my estimate of coal reserve wherever the Ohio Geological Survey has shown a considerable area 3.5 feet or more in thickness. Minable areas are present in Belmont, Harrison, and Noble Counties. While there is at present no demand for this coal there will come a time in the future when it will be of great value.

There are many thin seams of coal that we have not taken into consideration. They are in the most part too thin or too inferior to be minable at present. Most of these thin seams will undoubtedly have value some time in the future.

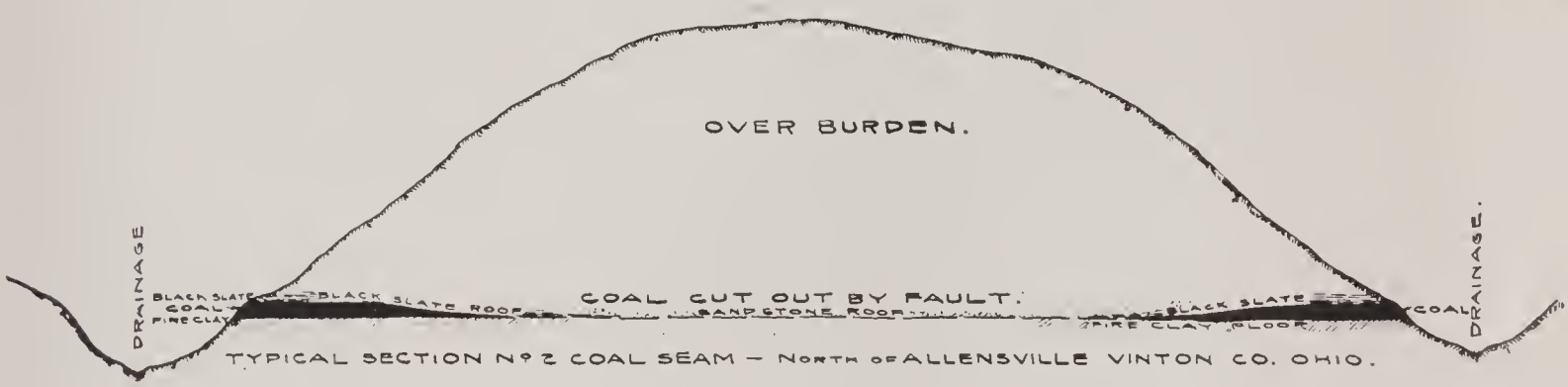
## THE UNCERTAINTY OF THE COAL SEAM AND THE DIFFICULTY OF ESTIMATING THE COAL RESERVE WITHOUT FULL KNOWLEDGE.

From what has already been said it will be seen that the coal seams have distinctive characteristics in different parts of the State. The same seam is found in minable condition in one locality, and is either absent or worthless at another. Not one of the seams continues unbroken, of uniform thickness or quality over the coal bearing area. The theory of coal formations suggests that each coal seam must constitute a relatively narrow strip of coal of indefinite width bordering the arm of the sea around which it grew. The mining of the various coal seams has exposed many kinds of faults, replacements, or cutouts, which have rendered a portion of the area unminable or worthless. Some of the coal seams have been found more dependable than others, yet experience has taught us that it is very unsafe to take for granted that any of them will hold true in character and quality through any considerable area.

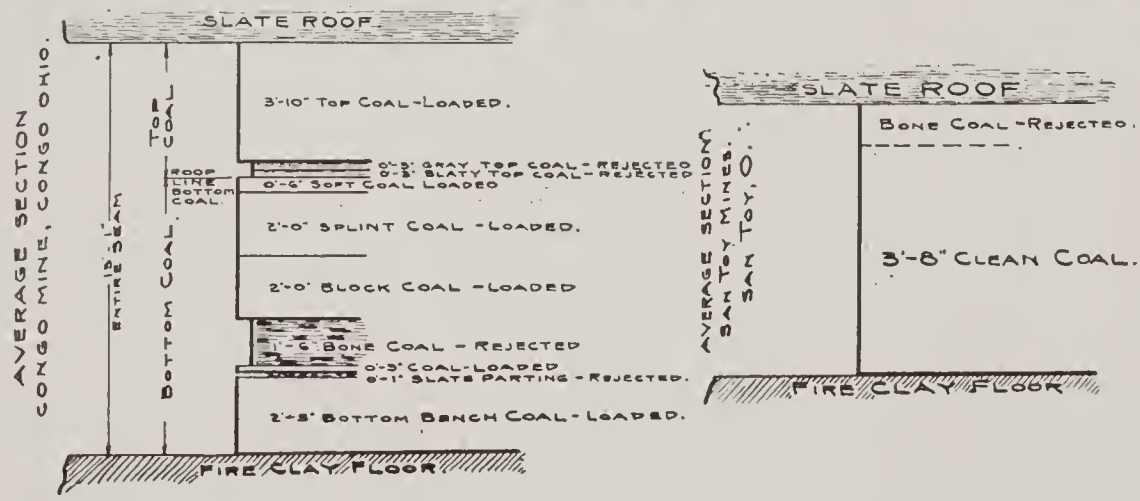
# Specific Examples Showing Irregularities in Coal Seams.

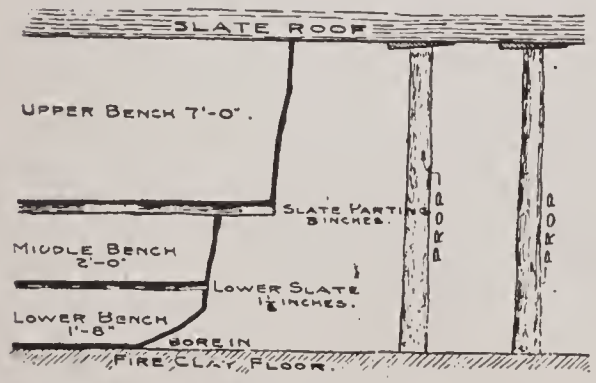



TYPICAL SECTION No 8 COAL SEAM – JENNINGS MINE UTLEY OHIO.

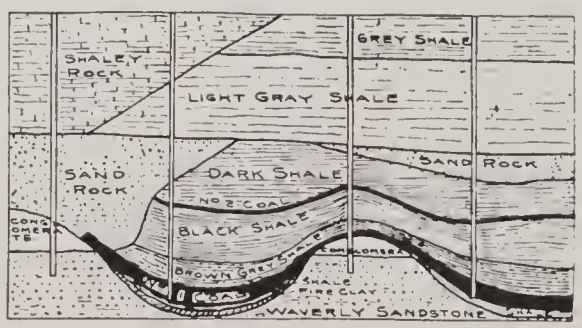



TYPICAL SECTION No 2 COAL SEAM – NORTH OF ALLENSVILLE VINTON CO. OHIO.

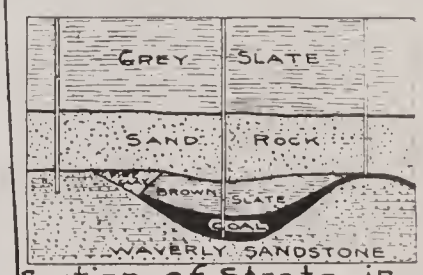



SECTION OF STRAITSVILLE COAL.



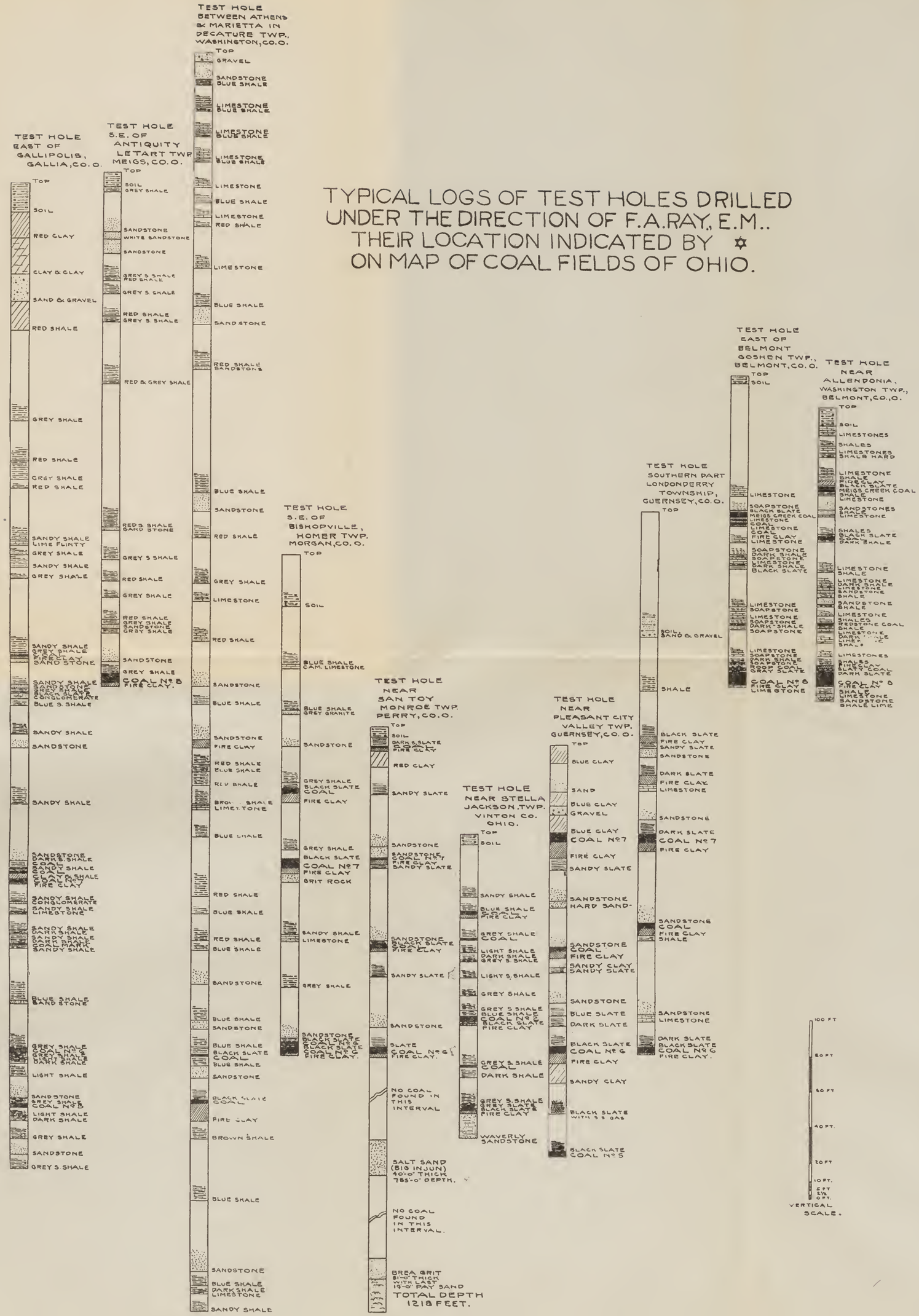

SECTION OF STRATA IN MAHONING VALLEY.

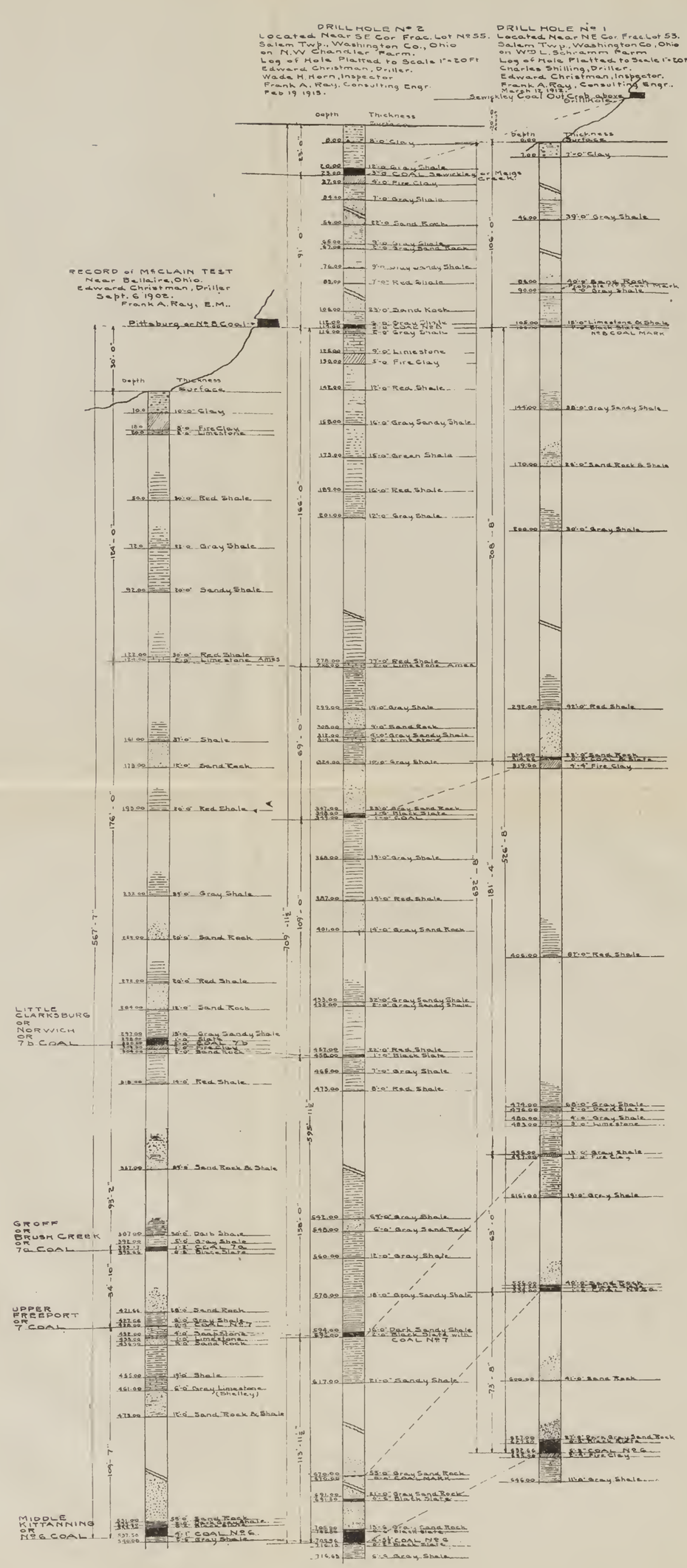


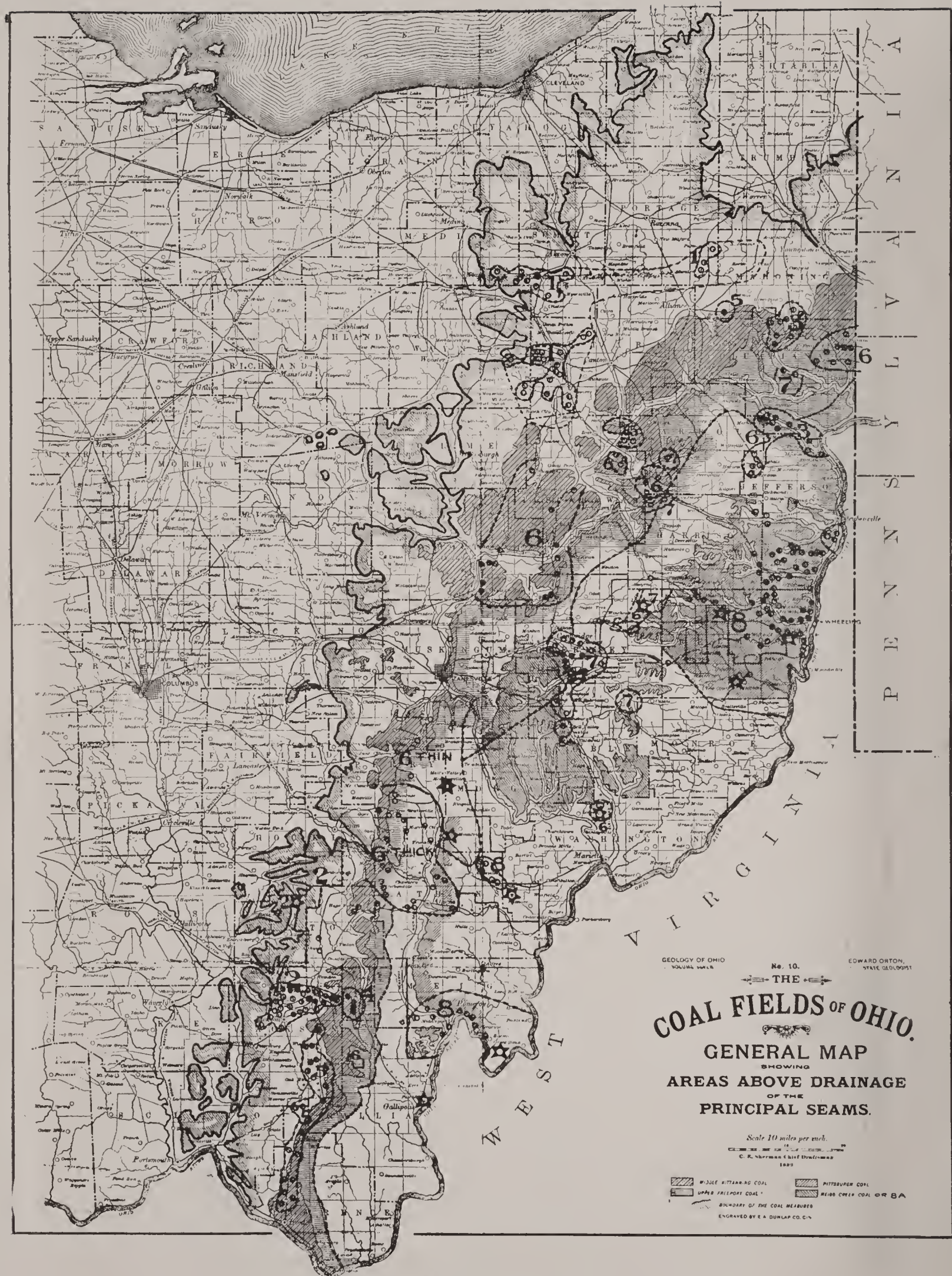

Section of Strata in Mahoning Valley.

The Jumbo Fault.

# TYPICAL LOGS OF TEST HOLES DRILLED UNDER THE DIRECTION OF F.A.RAY, E.M.. THEIR LOCATION INDICATED BY ✡ ON MAP OF COAL FIELDS OF OHIO.






Minable Coal Areas in Ohio.

Such conditions as these render it impossible to make an accurate estimate of Ohio coal reserve until the whole of its coal areas have been thoroughly prospected by mining and drilling, and the minable coal areas have all been definitely located.

## PROVEN COAL AREA USED IN COAL RESERVE ESTIMATE.

(See Map, Page 28.)

The writer has located all of the important coal mines as nearly as possible on Dr. Orton's map of the Ohio Coal Fields, and has made use of these locations together with records of drilling to define the areas of proven coal. The probable unexplored coal area is in most cases all of the territory not covered by proven areas lying between the outcrop on the west and an arbitrary easterly and westerly line connecting the eastern extremities of proven fields.

The thickness of the coal used for the various fields represents the average measured sections of clean coal taken from the mines or from drilling records.

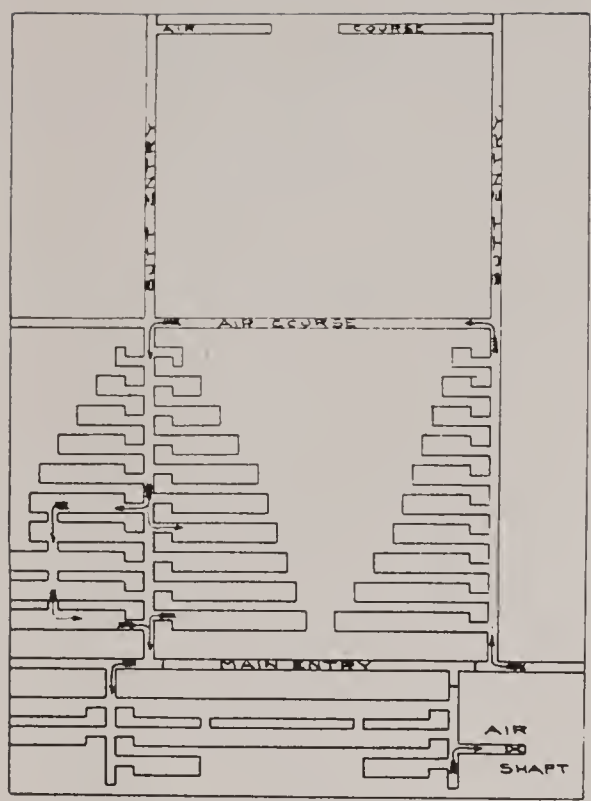
Fifteen hundred tons run of mine per vertical foot per acre have been used as a constant for all coal in estimating the tonnage. The writer has endeavored to be conservative and give the various fields full credit for all the coal the known facts will warrant.

## LOSSES IN MINING.

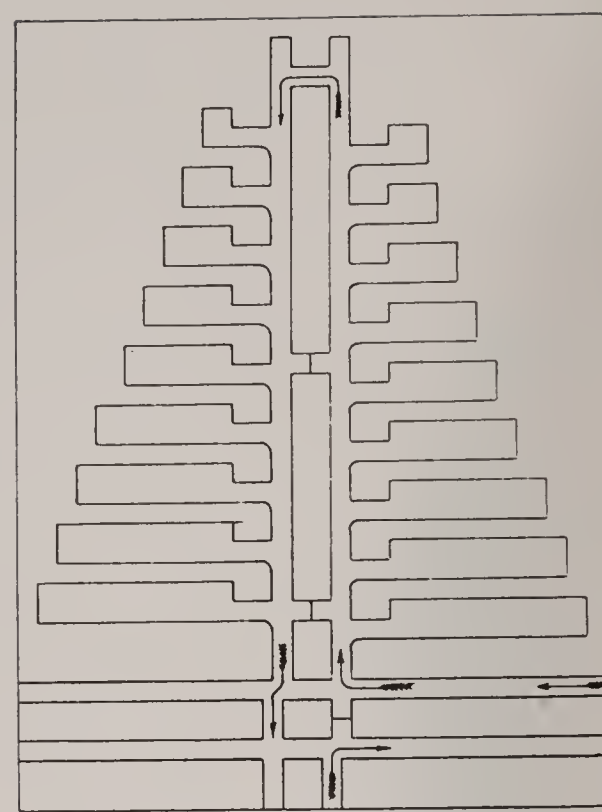
The amount of coal that has been lost in the process of mining in Ohio is a question of judgment about which there may be widely differing opinions. There is no doubt but that such losses were greater in the early days of Ohio mining than they are now with the present improved methods and systems of mining. A loss equal to 30% of the coal mined is assumed and added to the total coal produced, which should give the total coal depleted from the State.

## COAL DEPLETION FOR OHIO.

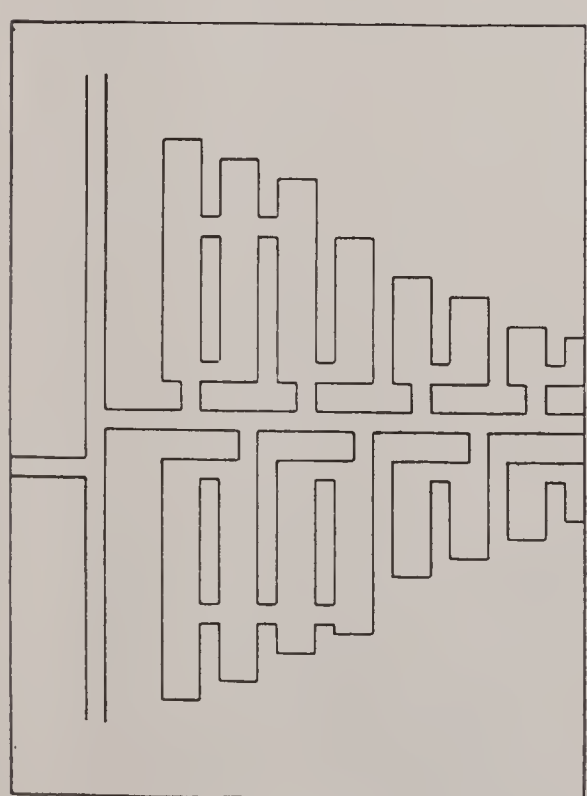
It is impossible to ascertain the actual amount of coal that has been mined in Ohio. Until 1872 no attempt was made to collect the statistics of the State's coal production. The early statistics give only the lump and nut coal produced, and even these are very incomplete. To all such figures have been added twenty per cent for pea and slack to bring the tonnage to run of mine coal. The earliest produc-



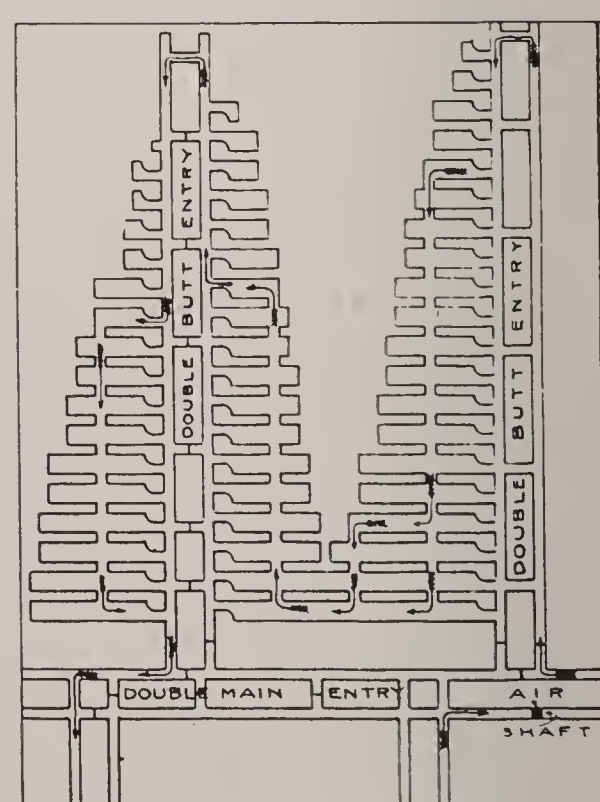

PLAN OF WORKING IN HOCKING VALLEY
SYSTEM OF MINING IN 1874
USED BY THE NELSONVILLE MINING CO.



DOUBLE ENTRY PLAN.
SYSTEM RECOMENDED IN 1876



PLAN.
SYSTEM OF MINING IN 1876.
USED BY STRAITSVILLE MINING CO.




PLAN OF WORKING
SYSTEM OF MINING IN 1876.
USED BY THE NEWARK COAL COMPANY,
IN THEIR SHAWNEE MINES.

Early Systems of Mining in Ohio.

Illustrating a Poor System of Mining.

Illustrating a Good System of Mining.

Prepared by

F. A. RAY, E. M.

PROFESSOR OF

Mine Engineering

School of Mines

Ohio State University

Columbus

1914

# COAL AREAS IN OHIO

| TOTAL AREA OF COAL MEASURES IN SQUARE MILES. | UNEXPLORED COAL AREAS. IN SQUARE MILES. | COUNTY | PROVEN MINABLE COAL IN SQUARE MILES. | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | No 8A COAL | No 8 COAL | No 7 COAL | No 6 THICK COAL | No 6 THIN COAL | No 5 COAL | No 4 COAL | No 3 COAL | No 2 COAL | No 1 COAL |
| AVERAGE THICKNESS CLEAN COAL | | | 3.5 | 5.5 | 5.2 | 7.0 | 3.5 | 3.25 | 4.0 | 3.5 | 2.7 | 3.0 |
| 483 | | ATHENS | | 18 | 6 | 156 | 10 | | | | | |
| 478 | | BELMONT | 270 | 415 | | | | | | | | |
| 400 | 160 | CARROLL | | | 10 | | 20 | 10 | | | | |
| 510 | 830 | COLUMBIANA | | | 15 | | 75 | | | 10 | | |
| 480 | 90 | COSHOCTON | | | | | 92 | | | | | |
| 500 | 100 | GALLIA | | 8 | | | | 20 | 5 | | | |
| 442 | 140 | GUERNSEY | | 10 | 90 | | 60 | | | | | |
| 850 | | HARRISON | 10 | 110 | 10 | | | | | | | |
| 215 | | HOCKING | | | | 31 | | | | | 3 | |
| 259 | | HOLMES | | | | | 10 | | | | | |
| 375 | 30 | JACKSON | | | | | | 40 | 4 | | 25 | |
| 360 | | JEFFERSON | | 110 | | | 50 | | | | | |
| 400 | 150 | LAWRENCE | | | | | | 50 | | | | |
| 585 | 55 | MAHONNING | | | | | | 8 | | 5 | | |
| 130 | | MEDINA | | | | | | | | | | 5 |
| 580 | 20 | MEIGS | | 112 | | | | | | | | |
| 550 | 800 | MUSKINGUM | | | 10 | | 50 | | | | | |
| 572 | 141 | NOBLE | 5 | | 15 | | | | | | | |
| 842 | | PERRY | | | | 37 | 133 | | | | | |
| 450 | | PORTAGE | | | | | | | | | | 5 |
| 850 | 90 | STARK | | | | | | | | | | 8 |
| 830 | | SUMMIT | | | | | | | | | | 3 |
| 180 | | TRUMBULL | | | | | | | | | | 2 |
| 850 | 100 | TUSCARAWAS | | | 5 | | 65 | 12 | | | | |
| 558 | 65 | VINTON | | | | | | 6 | 5 | 4 | 4 | 1 |
| 540 | | WASHINGTON | | | | | 5 | | | | | |
| 155 | | WAYNE | | | | | | | | | | 5 |
| 851 | | MORGAN | | | | | 92 | | | | | |
| 176 | | SCIOTO | | | | | | | 2 | | | |
| 405 | | MONROE | | 14 | | | | | | | | |
| 11396 | 1751 | TOTAL | 285 | 797 | 161 | 224 | 662 | 143 | 16 | 19 | 32 | 29 |

TAKEN FROM THE COAL RESOURCES OF THE WORLD VOLUME I PAGE XVIII.

ESTIMATE OF THE COAL RESERVES OF THE WORLD

| NAMES OF COUNTRIES | TOTAL TONS COAL |
|---|---|
| OCEANIA | 170,410,000,000 |
| ASIA | 1,279,586,000,000 |
| AFRICA | 57,839,000,000 |
| NEW FOUNDLAND | 500,000,000 |
| CANADA | 1,234,269,000,000 |
| CENTRAL AMERICA | 5,000,000 |
| SOUTH AMERICA | 32,097,000,000 |
| EUROPE | 784,190,000,000 |
| UNITED STATES | 3,838,657,000,000 |
| TOTAL | 7,397,553,000,000 |

## ESTIMATED TONS BY COUNTIES OF PROVEN RUN OF MINE COAL ORIGINALLY CONTAINED BY THE VARIOUS MINABLE COAL SEAMS — THE TOTAL PRODUCTION TO 1913 — THE ESTIMATED TONS OF UNMINED COAL IN OHIO —

| COUNTY | TONS OF RUN OF MINE COAL IN VARIOUS COAL SEAMS - OHIO - | | | | | | | | | | TOTAL TONS R. OF M. COAL ALL KINDS. | TOTAL COAL PRODUCTION 1828 TO 1913. | TOTAL ESTIMATED REMAINING PROVEN COAL. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No 8A SEAM | No 8 SEAM | No 7 SEAM | No 6 THICK SEAM | No 6 THIN SEAM | No 5 SEAM | No 4 SEAM | No 3 SEAM | No 2 SEAM | No 1 SEAM | | | |
| AVERAGE THICKNESS | 3.5 FT. | 5.5 FT. | 5.2 FT. | 7.0 FT. | 3.5 FT. | 3.25 FT. | 4.0 FT. | 3.5 FT. | 2.7 FT. | 3.0 FT. | | | |
| ATHENS | | 95,040,000 | 29,952,000 | 1,048,320,000 | 33,600,000 | | | | | | 1,206,912,000 | 75,990,161 | 1,130,921,839 |
| BELMONT | 907,200,000 | 2,191,200,000 | | | | | | | | | 3,098,400,000 | 79,440,330 | 3,018,959,670 |
| CARROLL | | | 49,920,000 | | 67,200,000 | 30,720,000 | | | | | 147,840,000 | 8,388,703 | 139,451,297 |
| COLUMBIANA | | | 74,880,000 | | 252,000,000 | | | 33,600,000 | | | 360,480,000 | 19,083,897 | 341,396,103 |
| COSHOCTON | | | | | 309,120,000 | | | | | | 309,120,000 | 8,385,394 | 300,734,606 |
| GALLIA | | 42,240,000 | | | | 61,440,000 | 19,200,000 | | | | 122,880,000 | 530,840 | 122,349,160 |
| GUERNSEY | | 52,800,000 | 449,280,000 | | 201,600,000 | | | | | | 703,680,000 | 52,538,894 | 651,141,106 |
| HARRISON | 33,600,000 | 580,800,000 | 49,920,000 | | | | | | | | 664,320,000 | 5,301,289 | 659,018,711 |
| HOCKING | | | | 208,320,000 | | | | | 7,776,000 | | 216,096,000 | 43,328,103 | 172,767,897 |
| HOLMES | | | | | 33,600,000 | | | | | | 33,600,000 | 508,300 | 33,091,700 |
| JACKSON | | | | | | 122,880,000 | 15,360,000 | | 64,800,000 | | 203,040,000 | 43,591,740 | 159,448,260 |
| JEFFERSON | | 580,800,000 | | | 168,000,000 | | | | | | 748,800,000 | 51,773,178 | 697,026,822 |
| LAWRENCE | | | | | | 153,600,000 | | | | | 153,600,000 | 4,429,822 | 149,170,178 |
| MAHONING | | | | | | 15,360,000 | | 16,800,000 | | | 32,160,000 | 4,307,158 | 27,852,842 |
| MEDINA | | | | | | | | | | 14,400,000 | 14,400,000 | 4,228,163 | 10,171,837 |
| MEIGS | | 451,584,000 | | | | | | | | | 451,584,000 | 9,767,920 | 441,816,080 |
| MUSKINGUM | | | 49,920,000 | | 168,000,000 | | | | | | 217,920,000 | 8,151,170 | 209,768,830 |
| NOBLE | 16,800,000 | | 74,880,000 | | | | | | | | 91,680,000 | 3,809,508 | 87,870,692 |
| PERRY | | | | 248,640,000 | 446,880,000 | | | | | | 695,520,000 | 60,754,657 | 634,765,343 |
| PORTAGE | | | | | | | | | | 14,400,000 | 14,400,000 | 3,300,650 | 11,099,350 |
| STARK | | | | | | | | | | 23,040,000 | 23,040,000 | 20,997,428 | 2,042,572 |
| SUMMIT | | | | | | | | | | 8,640,000 | 8,640,000 | 3,088,303 | 5,551,697 |
| TRUMBULL | | | | | | | | | | 5,760,000 | 5,760,000 | 2,077,722 | 3,682,278 |
| TUSCARAWAS | | | 24,960,000 | | 218,400,000 | 36,864,000 | | | | | 280,224,000 | 27,696,452 | 252,527,548 |
| VINTON | | | | | | 18,432,000 | 19,200,000 | 15,200,000 | 7,680,000 | 11,520,000 | 70,032,000 | 3,376,141 | 66,655,859 |
| WASHINGTON | | | | | 16,800,000 | | | | | | 16,800,000 | 81,478 | 16,718,522 |
| WAYNE | | | | | | | | | | 14,400,000 | 14,400,000 | 4,809,502 | 9,591,498 |
| MORGAN | | | | | 309,120,000 | | | | | | 309,120,000 | 2,004,653 | 307,115,347 |
| SCIOTO | | | | | | | 300,000 | | | | 300,000 | 178,414 | 121,586 |
| MONROE | | 73,920,000 | | | | | | | | | 73,920,000 | 29,292 | 73,890,708 |
| TOTALS | 957,600,000 | 4,068,384,000 | 803,712,000 | 1,505,280,000 | 2,224,320,000 | 489,296,000 | 54,060,000 | 65,600,000 | 80,256,000 | 92,160,000 | 10,288,668,000 | 551,948,062 | 9,736,719,938 |
| TOTAL PRODUCTION ALL COUNTIES 1828 TO 1883 | | | | | | | | | | | | ADD 109,956,583 | LESS 109,956,583 |
| ESTIMATED 30% LOSS IN MINING TOTAL COAL PRODUCED IN OHIO TO 1913 | | | | | | | | | | | | ADD 198,571,393 | LESS 198,571,393 |
| TOTAL TONS PROVEN COAL — TOTAL TONS EXHAUSTED COAL — TOTAL TONS PROVEN COAL REMAINING — | | | | | | | | | | | 10,288,668,000 | 860,476,038 | 9,428,191,962 |

COUNTIES SLIGHTLY EXPLORED

GALLIA

WASHINGTON

MONROE

— RECAPITULATION —

PROBABLE TONS COAL IN 1751 SQ. MILES UNEXPLORED AREA.....4,000,000,000

TOTAL TONS PROVEN COAL REMAINING.....9,428,191,962

TOTAL TONS ESTIMATED OHIO COAL RESERVE.....13,428,191,962

tion statistics obtainable for this publication begin with 1828, which is probably at or near to the beginning of the Ohio coal production. The earliest production statistics of counties begin in 1883, and have been collected and published in the reports of the Chief Mine Inspector.

The Chart page shows the tabulated results of the writer's estimate of Ohio proven minable coal. It is estimated that there is at least 1731 square miles of unexplored probable coal area. In this estimate it is assumed that 80 per cent. of this area contains one minable seam of coal three feet thick. This estimated quantity is added to the amount of proven coal tonnage. In four of the most important districts these estimates are compared with the estimates made by well-known mining engineers employed in these districts. In each instance the writer's estimates have been somewhat larger.

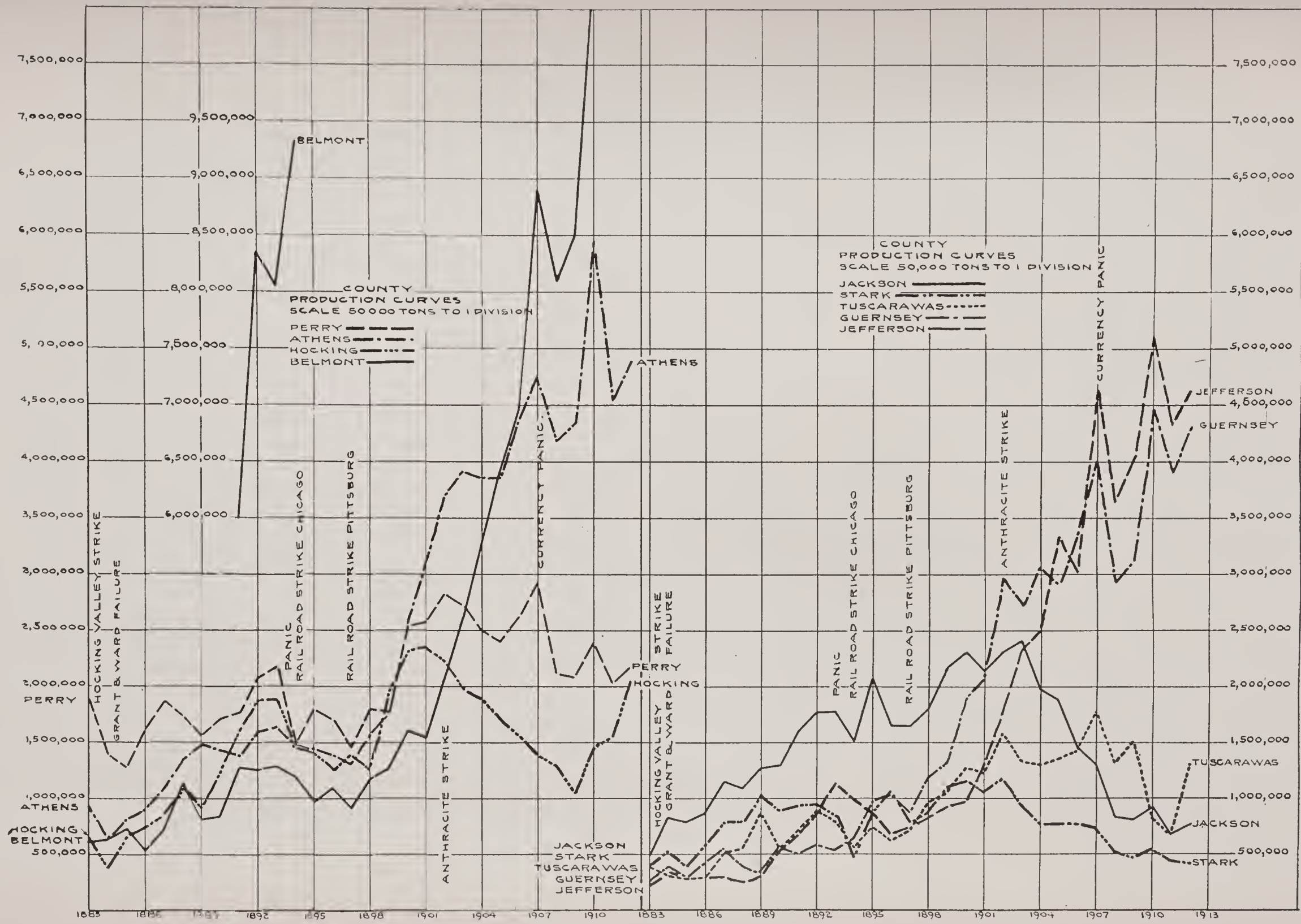
On this basis the total Ohio coal reserve amounts to 13,428,000,000 tons, or enough to fill a train of 50-ton cars long enough to reach 73 times around the earth. Yet this amounts to little more than one-sixth of Mr. M. R. Campbell's estimate of Ohio coal reserve.

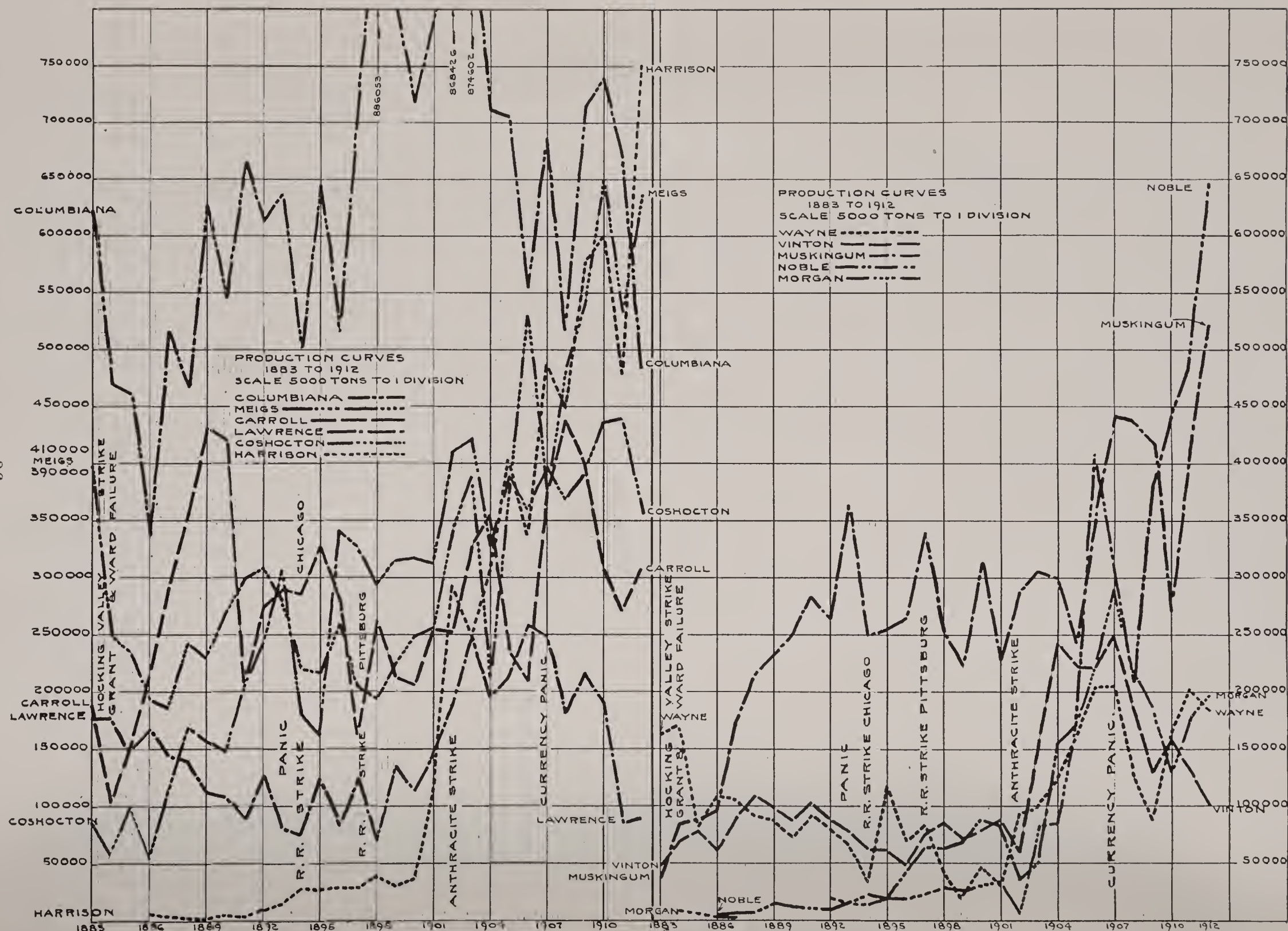
## DEPLETION CURVES.

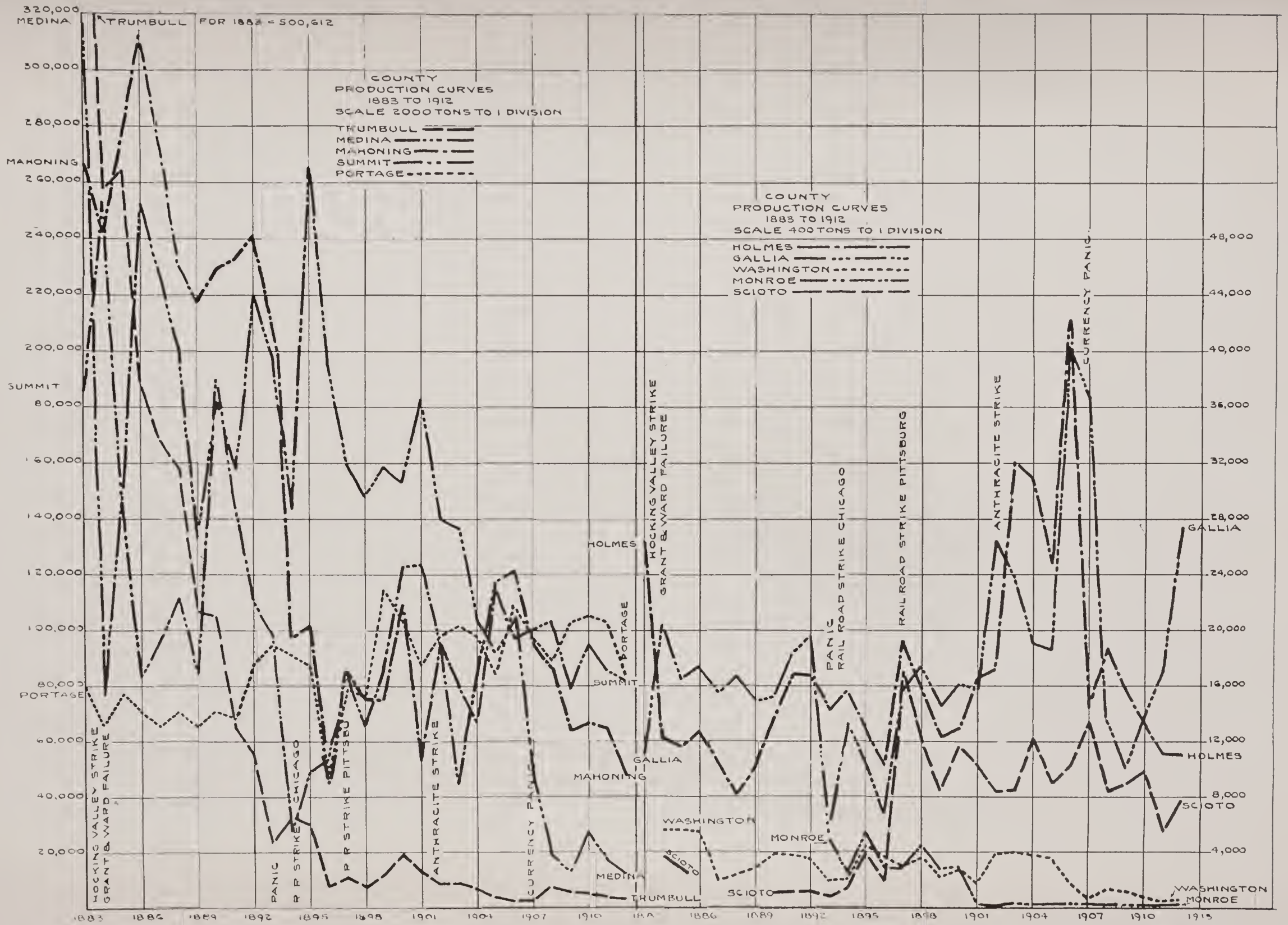
With the object of studying the depletion of coal areas, the writer has platted the annual production curves of the counties for the years 1883 to 1912, inclusive. Three distinct types of curves are developed which indicate three classes of coal producing counties: those in which the annual production was at its maximum at the beginning of the curve and gradually became less; those counties which began small and increased year by year to the maximum, holding that for several years, then gradually lessening in production to the end of the curve. The third class is for counties whose annual production has not yet reached the maximum.

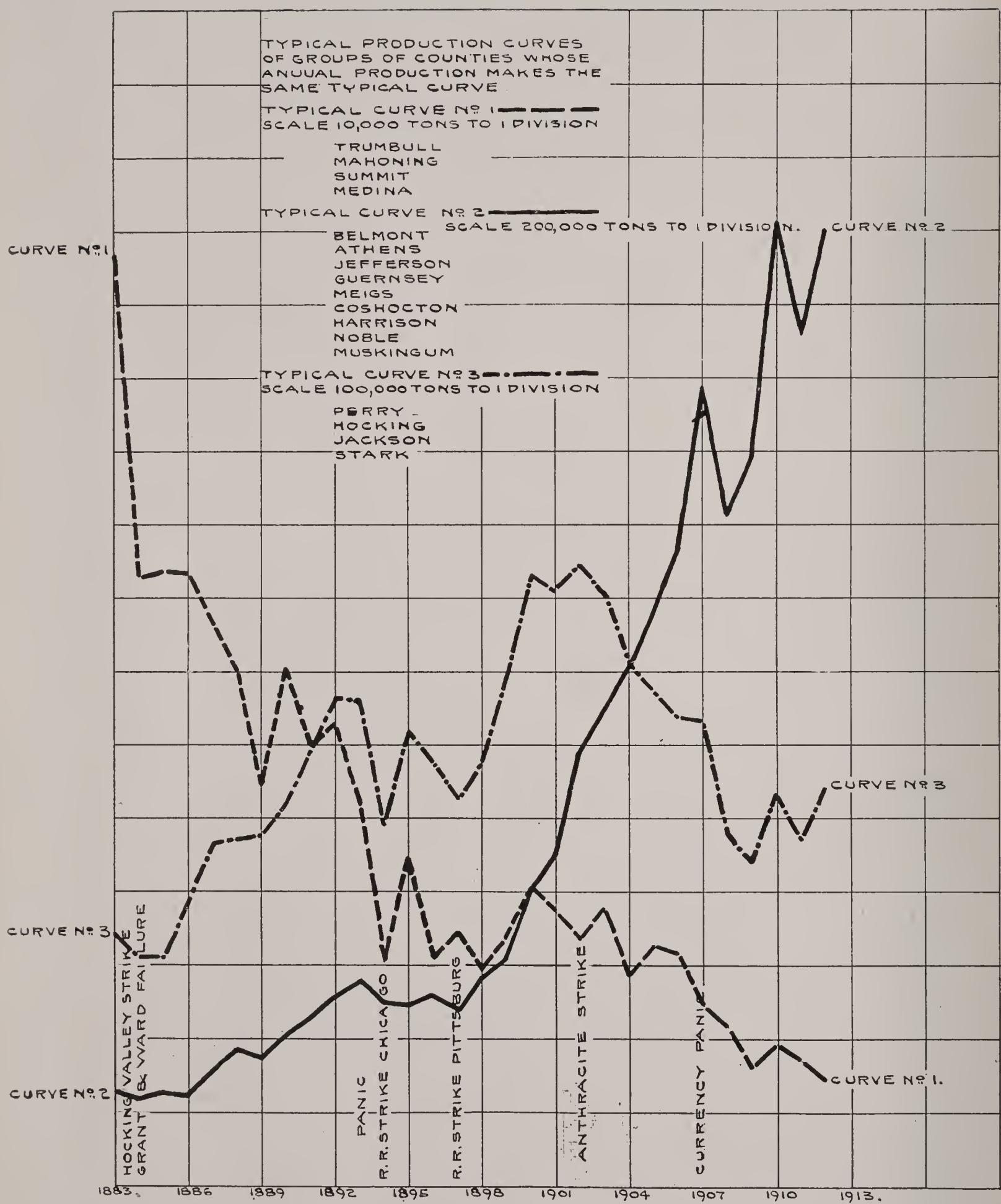
The typical curves indicate to some extent the degree of exhaustion of the coal fields. None of the Ohio districts have been actively productive for more than fifty years, and yet most of them begin to show a decline and some of them show decided symptoms of exhaustion.

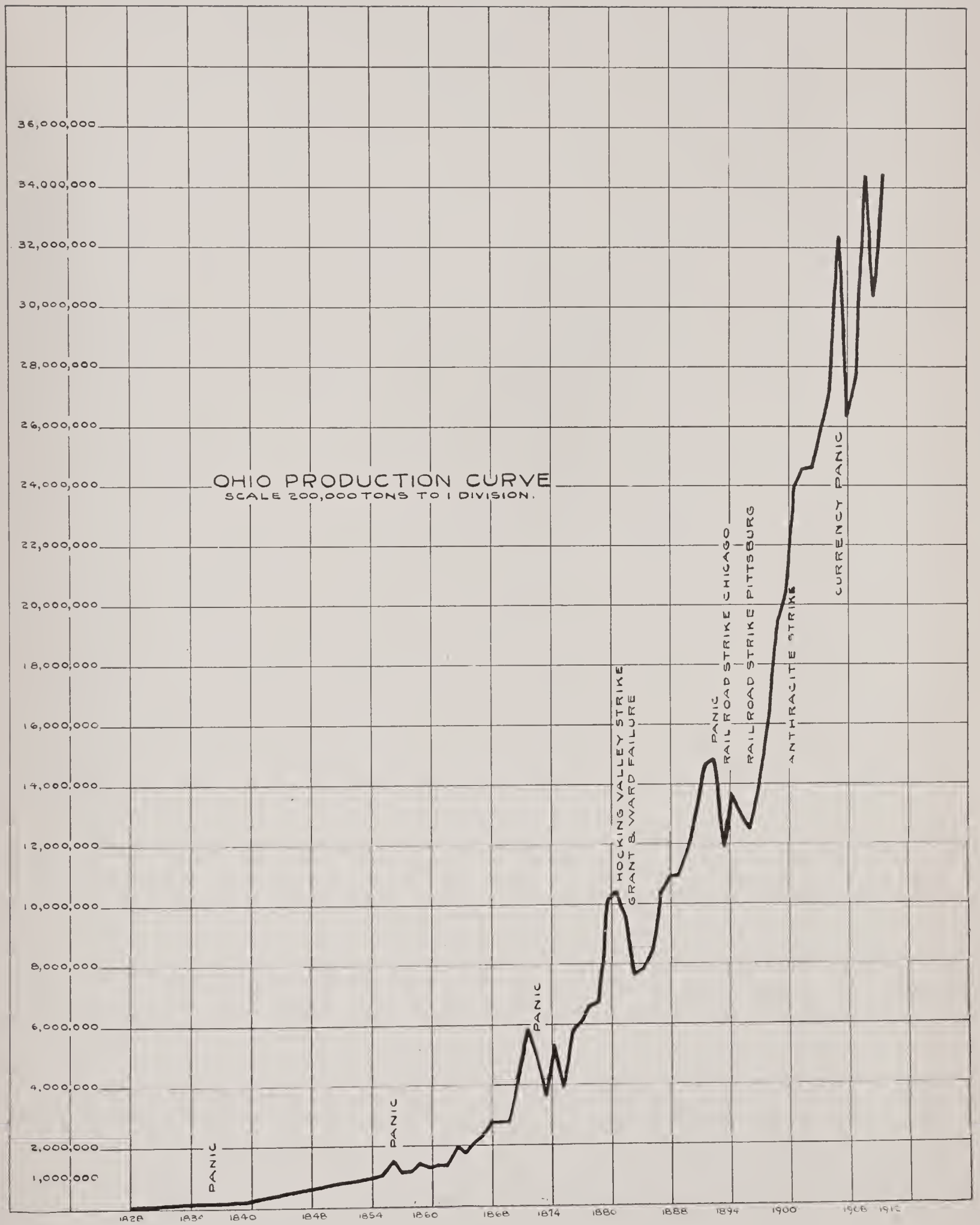
With the knowledge that our coal supply is definite and that its depletion is going on with increasing rapidity, we naturally inquire if there are not practical ways of conservation by the stopping of mining losses. The present average loss in mining in Ohio amounts to 30 per cent, excluding defective coal that is left in the mine and usually lost.

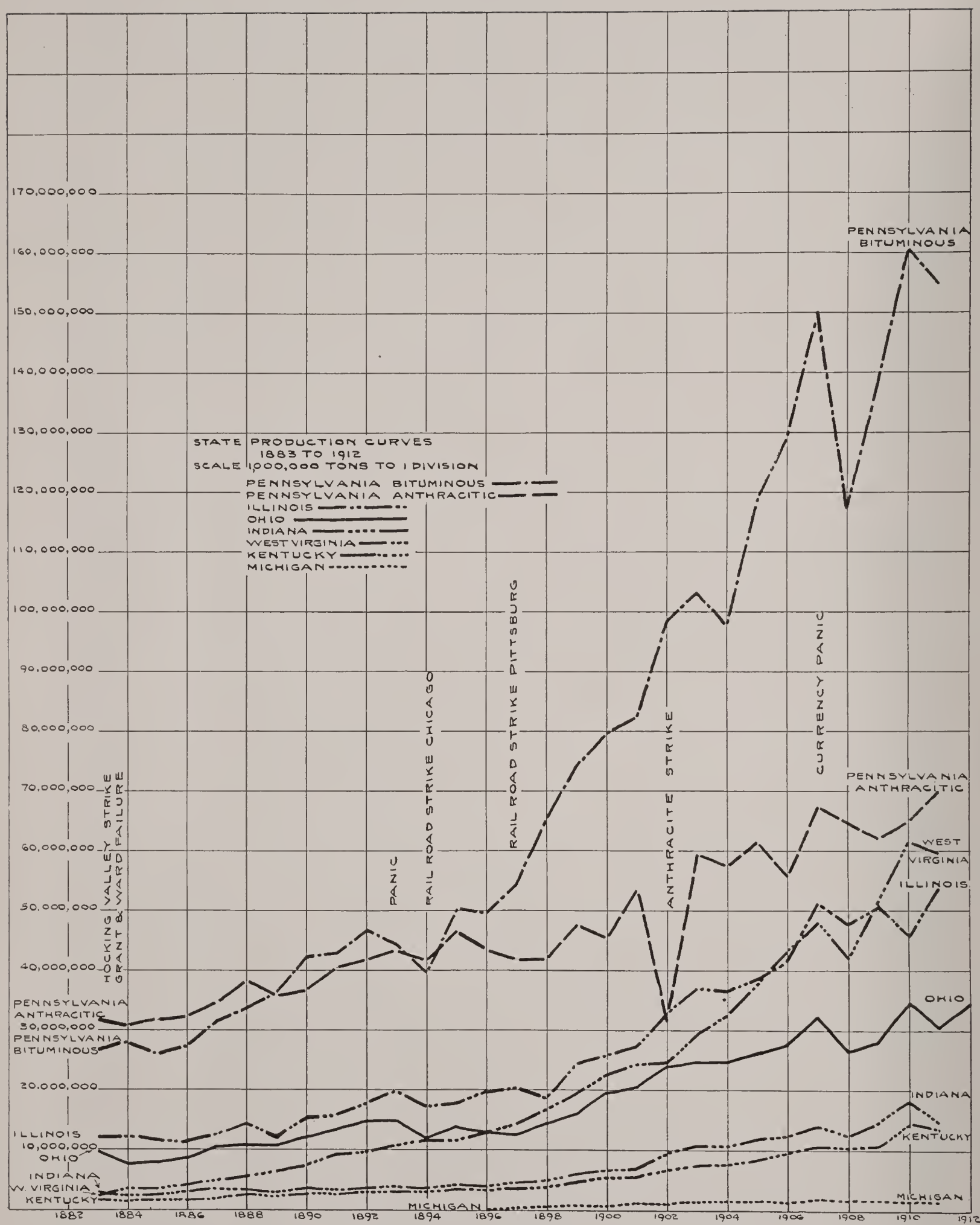

COUNTY
PRODUCTION CURVES
SCALE 50000 TONS TO 1 DIVISION
PERRY
ATHENS
HOCKING
BELMONT
COUNTY
PRODUCTION CURVES
SCALE 50,000 TONS TO 1 DIVISION
JACKSON
STARK
TUSCARAWAS
GUERNSEY
JEFFERSON
BELMONT
ATHENS
PERRY
HOCKING
ATHENS
HOCKING
BELMONT
PERRY
JACKSON
STARK
TUSCARAWAS
GUERNSEY
JEFFERSON
JEFFERSON
GUERNSEY
TUSCARAWAS
JACKSON
STARK
HOCKING VALLEY STRIKE
GRANT & WARD FAILURE
PANIC
RAIL ROAD STRIKE CHICAGO
RAIL ROAD STRIKE PITTSBURG
ANTHRACITE STRIKE
CURRENCY PANIC
7,500,000
7,000,000
6,500,000
6,000,000
5,500,000
5,000,000
4,500,000
4,000,000
3,500,000
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
9,500,000
9,000,000
8,500,000
8,000,000
7,500,000
7,000,000
6,500,000
6,000,000
1883
1886
1889
1892
1895
1898
1901
1904
1907
1910
1913


PRODUCTION CURVES
1883 TO 1912
SCALE 5000 TONS TO 1 DIVISION
COLUMBIANA
MEIGS
CARROLL
LAWRENCE
COSHOCTON
HARRISON
WAYNE
VINTON
MUSKINGUM
NOBLE
MORGAN
886053
868426
874602
HOCKING VALLEY STRIKE & WARD FAILURE
GRANT
CHICAGO
PANIC
R. R. STRIKE
PITTSBURG
ANTHRACITE STRIKE
CURRENCY PANIC
750000
700000
650000
600000
550000
500000
450000
410000
390000
350000
300000
250000
200000
150000
100000
50000
1883
1886
1889
1892
1895
1898
1901
1904
1907
1910
1912


TRUMBULL FOR 1883 = 500,612
COUNTY
PRODUCTION CURVES
1883 TO 1912
SCALE 2000 TONS TO 1 DIVISION
TRUMBULL
MEDINA
MAHONING
SUMMIT
PORTAGE
COUNTY
PRODUCTION CURVES
1883 TO 1912
SCALE 400 TONS TO 1 DIVISION
HOLMES
GALLIA
WASHINGTON
MONROE
SCIOTO
320,000
MEDINA
300,000
280,000
MAHONING
260,000
240,000
220,000
200,000
SUMMIT
180,000
160,000
140,000
120,000
100,000
80,000
PORTAGE
60,000
40,000
20,000
48,000
44,000
40,000
36,000
32,000
28,000
24,000
20,000
16,000
12,000
8,000
4,000
HOCKING VALLEY STRIKE
GRANT & WARD FAILURE
PANIC
R R STRIKE CHICAGO
R R STRIKE PITTSBURG
ANTHRACITE STRIKE
CURRENCY PANIC
HOCKING VALLEY STRIKE
GRANT & WARD FAILURE
PANIC
RAIL ROAD STRIKE CHICAGO
RAIL ROAD STRIKE PITTSBURG
ANTHRACITE STRIKE
CURRENCY PANIC
HOLMES
PORTAGE
SUMMIT
GALLIA
MAHONING
WASHINGTON
MONROE
SCIOTO
MEDINA
TRUMBULL
SCIOTO
GALLIA
HOLMES
SCIOTO
WASHINGTON
MONROE
1883
1886
1889
1892
1895
1898
1901
1904
1907
1910
1913


TYPICAL PRODUCTION CURVES
OF GROUPS OF COUNTIES WHOSE
ANUUAL PRODUCTION MAKES THE
SAME TYPICAL CURVE
TYPICAL CURVE Nº 1
SCALE 10,000 TONS TO 1 DIVISION
TRUMBULL
MAHONING
SUMMIT
MEDINA
TYPICAL CURVE Nº 2
SCALE 200,000 TONS TO 1 DIVISION.
BELMONT
ATHENS
JEFFERSON
GUERNSEY
MEIGS
COSHOCTON
HARRISON
NOBLE
MUSKINGUM
TYPICAL CURVE Nº 3
SCALE 100,000 TONS TO 1 DIVISION
PERRY
HOCKING
JACKSON
STARK
CURVE Nº 1
CURVE Nº 2
CURVE Nº 3
CURVE Nº 3
CURVE Nº 2
CURVE Nº 1.
HOCKING VALLEY STRIKE
GRANT & WARD FAILURE
PANIC
R.R. STRIKE CHICAGO
R.R. STRIKE PITTSBURG
ANTHRACITE STRIKE
CURRENCY PANIC
1883.
1886
1889
1892
1895
1898
1901
1904
1907
1910
1913.


OHIO PRODUCTION CURVE
SCALE 200,000 TONS TO 1 DIVISION.
36,000,000
34,000,000
32,000,000
30,000,000
28,000,000
26,000,000
24,000,000
22,000,000
20,000,000
18,000,000
16,000,000
14,000,000
12,000,000
10,000,000
8,000,000
6,000,000
4,000,000
2,000,000
1,000,000
PANIC
PANIC
PANIC
HOCKING VALLEY STRIKE
GRANT & WARD FAILURE
PANIC
RAIL ROAD STRIKE CHICAGO
RAIL ROAD STRIKE PITTSBURG
ANTHRACITE STRIKE
CURRENCY PANIC
1828
1836
1840
1848
1854
1860
1868
1874
1880
1888
1894
1900
1908
1912


STATE PRODUCTION CURVES
1883 TO 1912
SCALE 1,000,000 TONS TO 1 DIVISION
PENNSYLVANIA BITUMINOUS
PENNSYLVANIA ANTHRACITIC
ILLINOIS
OHIO
INDIANA
WEST VIRGINIA
KENTUCKY
MICHIGAN
170,000,000
160,000,000
150,000,000
140,000,000
130,000,000
120,000,000
110,000,000
100,000,000
90,000,000
80,000,000
70,000,000
60,000,000
50,000,000
40,000,000
30,000,000
20,000,000
10,000,000
HOCKING VALLEY STRIKE
GRANT & WARD FAILURE
PANIC
RAIL ROAD STRIKE CHICAGO
RAIL ROAD STRIKE PITTSBURG
ANTHRACITE STRIKE
CURRENCY PANIC
PENNSYLVANIA BITUMINOUS
PENNSYLVANIA ANTHRACITIC
WEST VIRGINIA
ILLINOIS
OHIO
INDIANA
KENTUCKY
MICHIGAN
1882
1884
1886
1888
1890
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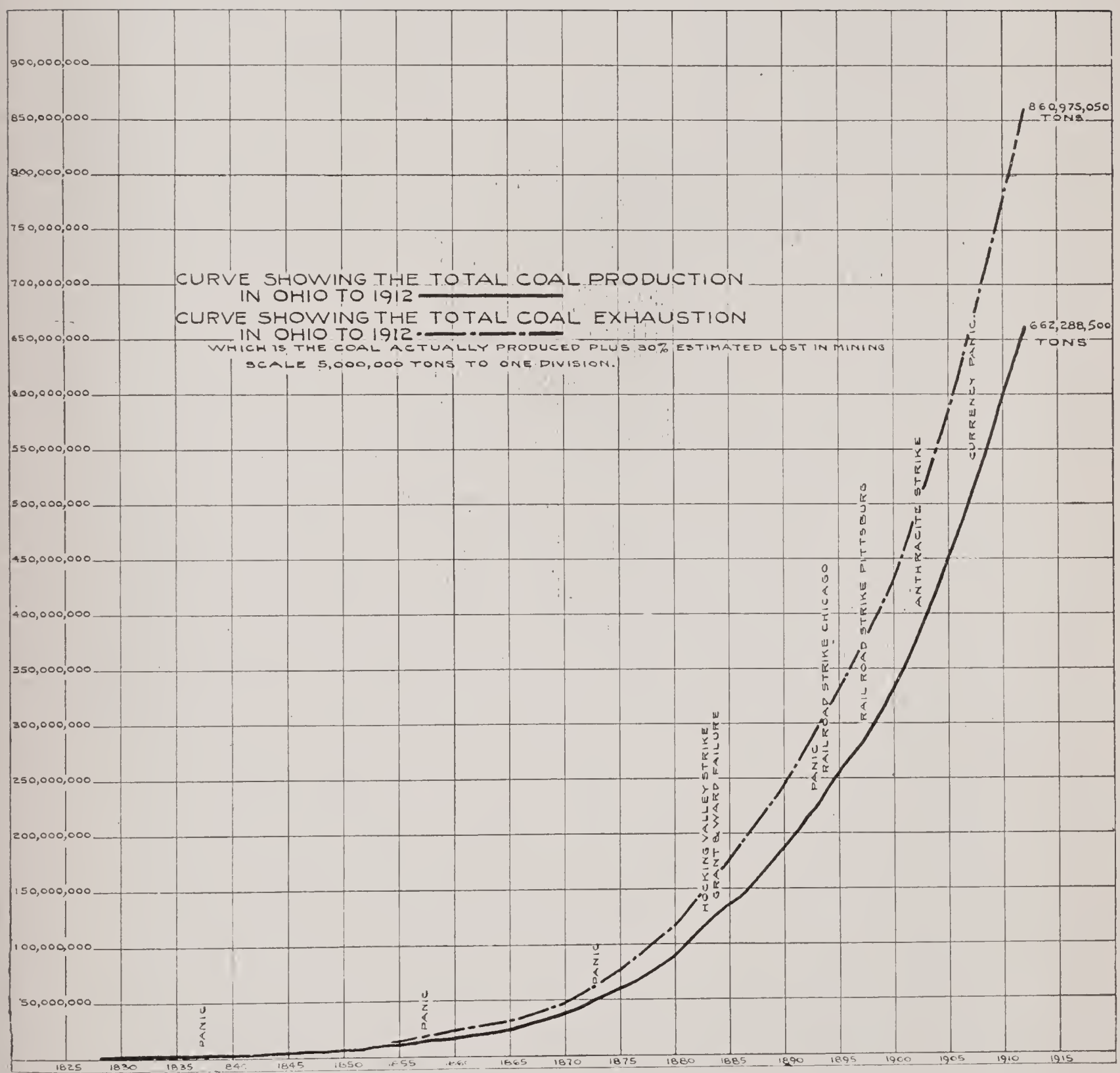
1894
1896
1898
1900
1902
1904
1906
1908
1910
1912


CURVE SHOWING THE TOTAL COAL PRODUCTION IN OHIO TO 1912
CURVE SHOWING THE TOTAL COAL EXHAUSTION IN OHIO TO 1912
WHICH IS THE COAL ACTUALLY PRODUCED PLUS 30% ESTIMATED LOST IN MINING
SCALE 5,000,000 TONS TO ONE DIVISION.
900,000,000
850,000,000
800,000,000
750,000,000
700,000,000
650,000,000
600,000,000
550,000,000
500,000,000
450,000,000
400,000,000
350,000,000
300,000,000
250,000,000
200,000,000
150,000,000
100,000,000
50,000,000
860,975,050 TONS
662,288,500 TONS
PANIC
PANIC
PANIC
HOCKING VALLEY STRIKE
GRANT & WARD FAILURE
PANIC
RAILROAD STRIKE CHICAGO
RAIL ROAD STRIKE PITTSBURG
ANTHRACITE STRIKE
CURRENCY PANIC
1825
1830
1835
1845
1865
1870
1875
1880
1885
1890
1895
1900
1905
1910
1915

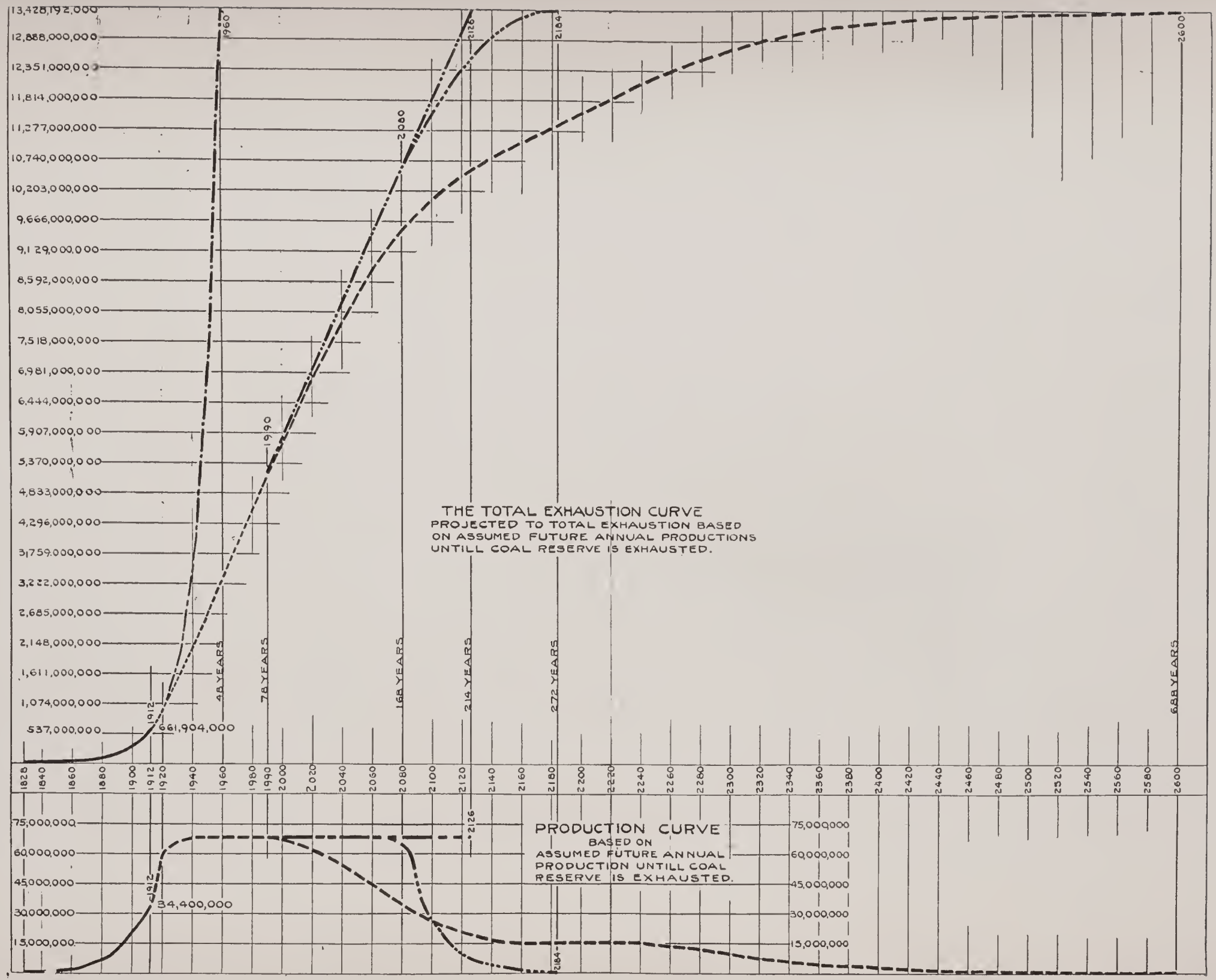
This loss could be materially reduced by raising the standards of competency of all engaged in mining coal, by employing more efficient systems and methods of mining. The necessary loss in mining ought not to exceed 15 per cent. of the minable coal. If this be true the unnecessary loss is 15 per cent and could be saved.

Unfortunately the attention of the public has been called to this one item of waste to the exclusion of all others. J. M. Searle, Chief of the Division of Smoke Inspector of Pittsburg, Pennsylvania, says that the unnecessary loss in the use of coal in Pittsburg is 20 per cent, an unnecessary loss for 1912 amounting to 1,121,283 tons, or $1,151,-283.00 for Pittsburg alone. This amount of unnecessary loss in the use of coal will undoubtedly hold true for the whole of the United States. The ordinary thermal efficiencies of main power units range from 15 to 33 per cent, which entails a loss in fuel consumed of 67 to 85 per cent. Should we not direct our efforts towards securing more efficient results in the use of coal?

## HOW LONG WILL OUR COAL LAST?

No one can predict the time when Ohio's coal reserve will be exhausted. I have prepared the curve page 39, which accurately shows what has taken place in annual production and total depletion from the beginning of coal production in Ohio to 1912. The total exhaustion curve shows that the annual production has in the past nearly doubled every ten years. See curve page 41. If this rate of increase should continue until total depletion, the coal will be exhausted in 48 years, which means at the end the annual production would have to be over 600,000,000 tons. See curve page 43. This rate of increase cannot go on indefinitely. There must come a time when the output of coal for Ohio will be reduced to its natural markets only, and the annual production will then remain practically constant up to the time of beginning decline, when the annual production will grow gradually less and finally cease when total exhaustion is reached.

If the annual output is allowed to double for the next ten years and then remain constant until the end, total exhaustion would be reached in 214 years. If this constant production were allowed to continue for 168 years, and the production on the declining side of the curve were the same as the beginning side, then the total depletion would be reached in 272 years. If the total exhaustion curve is platted from the assumed annual production curve shown, then the total depletion will be reached in 688 years. The total depletion will probably


THE TOTAL EXHAUSTION CURVE
PROJECTED TO TOTAL EXHAUSTION BASED ON ASSUMED FUTURE ANNUAL PRODUCTIONS UNTILL COAL RESERVE IS EXHAUSTED.
PRODUCTION CURVE
BASED ON ASSUMED FUTURE ANNUAL PRODUCTION UNTILL COAL RESERVE IS EXHAUSTED.
13,428,192,000
12,888,000,000
12,351,000,000
11,814,000,000
11,277,000,000
10,740,000,000
10,203,000,000
9,666,000,000
9,129,000,000
8,592,000,000
8,055,000,000
7,518,000,000
6,981,000,000
6,444,000,000
5,907,000,000
5,370,000,000
4,833,000,000
4,296,000,000
3,759,000,000
3,222,000,000
2,685,000,000
2,148,000,000
1,611,000,000
1,074,000,000
537,000,000
661,904,000
34,400,000
75,000,000
60,000,000
45,000,000
30,000,000
15,000,000
48 YEARS
78 YEARS
168 YEARS
214 YEARS
272 YEARS
688 YEARS
1912
1960
1990
2080
2126
2184
2600

be reached at some time before this extreme, unless our unexplored coal areas develop bodies of coal that are now unknown to us, and more efficient substitutes for coal are discovered.

All of this is pure speculation. Our knowledge is yet deficient. We must know more of the facts, both as to the coal reserve and the future consumption, before the date of total depletion of the Ohio coal reserve can be predicted.

Dr. Orton in a tribute to what the coal miners have done for geology said: "I have to believe that much that we have already gained is solid knowledge; that is, firmly fixed no more to move, but no one sees more clearly than I how fragmentary and incomplete it all is after all."

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| Map—The Coal Fields of the World | 5 |
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| The Coal Fields of the United States | 7 |
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